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ARTICLE XIII.

SYNOPSIS OF THE CYPRINIDÆ OF PENNSYLVANIA.

BY EDWARD D. COPE.

Read Oct. 19, 1866.

THOUGH the fishes of this family are known to every boy as minnows, shiners, &c., and to the fisherman as his best bait for the capture of the rapacious bass, pike, &c., to the public generally they possess little interest or value. They are nevertheless the most numerous of the vertebrate animal life of our fresh-water streams, both in individuals and species, though to the uneducated eye, the number of the latter would appear far less than is really the case. This is in part occasioned by the general absence of pattern or shade of coloration; the prevailing silver reflections perhaps serve as efficient means of concealment.

The Cyprinidæ attain a great development in the Palæotropical and Palæarctic regions, and occur in the Æthiopian. They exist in numbers but of a smaller and less vigorous growth in the Regio Nearctica, but cease with the northern section of the Neotropical, where their place, as well as that of several other families, appears to be supplied by the more generalized, and as respects their reproductive organs, inferior form of Characinidæ. In the lowest fauna, the R. Australis, the family is also wanting, while Characinoid types people the fresh waters.

The family is associated in North America and Eastern Asia* with a nearly allied form, the Catastomidæ,† and in the Old World, with a second family, the Cobitidæ,‡ which together form the order Euentognathi of Gill. This group was first separated accurately as a family by Agassiz. It is defined as follows:

Inferior pharyngeal bones prolonged upwards into two falciform tooth-bearing vertical jaws; brain-cavity of the cranium prolonged between the orbits; maxillary bones well developed. Fourth ventricle of the brain with a median lobus impar behind the cerebellum.

* Vide Bleeker's discovery of a *Carpiodes chinensis* in China.

† Characterized by Gill, Proceed. Academy, 1861, 6.

‡ Cobitoidæ and Homalopteroidæ; Gill, Proc. Ac. Phila., p. 6.

The family of the Cyprinidæ is thus defined:

¹ Pharyngeal bones short, with an external ala, supporting a short series of not more than seven teeth, which have cylindric or sub-cylindric shanks. Mouth bounded above by the premaxillary only, not surrounded with fleshy lips. Dorsal fin with an osseous spine.*

My object is to present here a brief outline of characteristics of the species found in the waters of our State, for the benefit of students, since the present state of the literature of the subject renders the study of them very laborious.

Three memoirs comprise most of our knowledge of the subject, viz., two by Prof. Agassiz, in Silliman's Journal, 1854-5, On the Fishes of the Tennessee River, and the Cyprinidæ of the Pacific Slope of North America, and one much more extended by Girard, in Proceedings Acad. Nat. Sciences, Phila., 1856, on the Cyprinidæ of the Mississippi Valley. Prof. Kirtland's Fishes of Ohio (Boston Journ. Nat. Hist.), and Storer's Synopsis of Fishes of North America (Trans. Americ. Academy), are also necessary to a comprehension of the subject.

Our genera as at present understood, are fifteen in number; they express the natural relations of twenty-eight species. These are mostly of small size, and bear so close a resemblance to each other as to be confounded by ordinary observers during the seasons when not in their nuptial dress. Then indeed the brilliancy of their coloring attracts the most indifferent, and they are caught to be admired in aquaria; but they only fade on removal from their native haunts. The gorgeous crimson of the *Argyrei*, the *Chrosomi*, and the *Clinostomi*, are in no wise inferior to the tints of the boasted trout in his brightest array, and the admired gold-fish does not gain by the comparison. A few species attain a moderate size; the *Stilbe americana* and *Semotilus corporalis* occur of two lb. weight, and the *Semotilus rhotheus* rarely reaches four.

The *Argyrei*, the *Chrosomi*, and the *Clinostomi* prefer the clearest and most sparkling rivulets, the home of the trout, whose rapid movements and bright tints they repeat; they occur everywhere, in close parties or little shoals. Some of the *Semotili* are fish of much vigor of movement, and prefer the rapid waters of the larger creeks; others are less

* The following are the characters given by Prof. Gill (l. c.), for this family:

"The body is oblong or moderately elongated, compressed or sub-cylindrical, and covered with scales of various sizes.

"The barbels vary in number from two to four, and in numerous genera are even entirely absent. The pectoral fins have broad vertical bases inserted in the usual manner on the sides above the breast. They have each a simple ray. The dorsal and anal fins are either with or without spines, which themselves are either simple or dentated. The pharyngeal bones have normally one constant row of normally five teeth, occasionally four, and often one or two supplementary rows of from one to three smaller teeth. The branchial apertures are of moderate size, and separated from each other by an isthmus of little or moderate width."

active, and with the sluggish *Exoglossa* and *Campostomæ*, glide in short gyrations in the depths of the clear and quiet pools of our forest streams. The *Stilbe* and *Hypsilepis cornutus*, with some *Hybopses*, do not dread the neighborhood of mankind; they are the denizens of the milldam and race, and are usually the chief ornaments of the "strings" of the urchins, whose wanderings have not attained the river or creek bank. They are equally abundant in the quiet parts of the large rivers, where their dimensions are quite dignified in comparison with the swarming *Hypsilepes*, *Alburnelli*, *Hybopses*, and *Hyborhynchi*, which prefer the same localities.

These differences of habit are associated with peculiarities of food and of the structure of the digestive system. Few families of vertebrates embrace as great a variety in these respects as the present one. There are carnivorous, insectivorous, and graminivorous genera, which are distinguished as among mammalia, the former by the abbreviation, the last by the elongation, of the alimentary canal; in the former the teeth are usually sharp-edged or hooked, in the latter truncate, hammer, or spoon-shaped. John Jacob Heckel, however, the author who has developed the characters of the Cyprinidæ more than any other, says in reference to this point: "It is known that in general the length of the alimentary canal, as well as the direction of the oral opening, corresponds to the manner of nourishment of the animal, but among our Cyprinidæ this rule has but a narrow application, since the common carp (*Cyprinus carpio*), whose alimentary canal is only double the length of the whole body, is as completely herbivorous as those East Indian species whose intestines are wound knot-like in a length of eleven times that of the body. On the contrary, the species of *Barbus*, whose alimentary canal is similar in length to that of *Cyprius*, or our *Rhodeus*, the only European which resembles the Indian species in the length and involution of its intestines, live altogether on animals."

In the American genera, as far as included in the scope of this essay, the peculiarities of the intestines correspond with the food. In the *Alburnellus rubrifrons*, they are but $\frac{4}{5}$ the length of head and body (excluding caudal fin). In *Hypsilepis kentukiensis*, *Photogenis leucops*, *Argyreus atronasmus* and *nasutus*, *Ericymba buccata*, and *Exoglossum maxillingua*, about $\frac{7}{9}$; the food of the last five species is insects and crustaceans, the last depending largely on mollusca. In the species of *Ceraticthys*, *Semotilus*, and *Hybopsis*, with *Hypsilepis cornutus*, $\frac{1}{2}$ to $\frac{5}{8}$, to equal the length; the habits, insectivorous. The genera with longer intestines are, first, *Stilbe* $1\frac{2}{3}$ to $1\frac{3}{4}$ the length; *Chrosomus*, *Hyborhynchus*, and *Pimephales* $2\frac{2}{3}$ to $2\frac{3}{4}$, and *Hybognathus* 4 times. The intestines in these are generally filled with a soft dark-colored slime, without remains of insects, but of vegetable origin. In the remarkable genus *Campostoma* the canal extends to between eight and nine times the length, and, like that of other vegetable-feeders, is usually found occupied by the ingesta for a considerable part of its length. The European genera most

nearly allied, *Chondrostoma* and *Rhodeus*, possess intestinal canals 2.66 and 3.5 times the length of the body respectively.

The alimentary canal in the Cyprinidæ offers no distinction into stomach and small and large intestine; its anterior portion is generally of greater diameter than that succeeding. The principle of its arrangement is that of a sigmoid with the three limbs appressed and in contact. In those genera with short intestines, the proximal flexure is anterior to the hinder extremity of the abdominal cavity, the distal, behind the anterior, thus reducing the median tract. Length is gained by extending the proximal flexure to near the vent and the anterior to near the head; while the additional complications of more vegetable-feeders take place first about the distal or anterior flexure, where portions of the middle and distal tracts may be together several times laterally folded, or new flexures may be added in the middle and distal tracts themselves. By the last mode, accommodation for the greatest extent is procured. In any case the proximal tract is not flexed, evidently that it may serve as a receptacle for the objects taken as food. The liver is attached to two, or sometimes three tracts, in a band or bands between them.

The Cyprinidæ of the Eastern district of North America appear to be referable to four tribes, as follows:

Dentary bones straight and flat, united together throughout their length; natatory bladder lying along the vertebral column, above the alimentary canal; opercular and mandibular bones not cavernous. COCHLOBORI.

Dentary bones slender, arched, and widely separated, except at their symphysis; natatory bladder lying along the vertebral column, and above the alimentary canal; opercular and mandibular bones with external cavernous chambers. CÆLOPHORI.

Dentary bones slender, arched, widely separated, except at their symphysis; natatory bladder lying along the vertebral column, and above the alimentary canal; opercular and mandibular bones without external cavernous chambers. EPICYSTI.

Dentary bones slender, arched, widely separated, except at their symphysis; natatory bladder suspended in the centre of the abdominal cavity by numerous convolutions of the alimentary canal which surround it; opercular and mandibular bones without external cavernous chambers. MESOCYSTI.

The genera are as follows:

TRIBE I. COCHLOBORI.

Barbels none. Premaxillaries not projectile; skin of lip and front continuous. Teeth 1, 4—4, 1 or 2, hooked, without masticatory surface. Dorsal fin above ventrals; anal basis short. Mouth inferior; mandible much contracted, with lobe on each side of base. EXOGLOSSUM.

TRIBE II. CÆLOPHORI.

Dorsal fin above ventrals; basis of anal short; teeth hooked, without masticatory surface, 1, 4—4, 0; mouth subinferior, small; scales moderate; lips normal. ERICYMBA.

TRIBE III. EPICYSTI.

GROUP I. Maxilla with barbels; pharyngeal teeth hooked, without masticatory surface; bony dorsal ray attached; alimentary canal shorter than to equal length of head and body (without caudal fin).

a. Premaxillaries projectile; lip separated by a dermal fold.

No terminal; two lateral maxillary barbels; teeth 2, 5—4, 2.

SEMOTILUS.

Two terminal, no lateral maxillary barbels; teeth 3, 5—5, 2.

GOBIO.

Two terminal, no lateral maxillary barbels; teeth 2, 4—4, 2, or the front row 1—1 or 0—0.

CERATICHTHYS.

aa. Premaxillaries not projectile; skin of lip and front continuous.

Two terminal, no lateral maxillary barbels; teeth 2, 4—4, 2; isthmus wide.

ARGYREUS.

GROUP II. No barbels; pharyngeal bones hooked, with or without masticatory surface; first (osseous) dorsal ray adherent.

a. Teeth of inner pharyngeal series 5—4 or 5—5 (two-rowed).

Dorsal fin above ventrals; teeth inner row 5—5, no masticatory surface; mouth terminal; scales usual surface exposed. (SQUALIUS.)

Dorsal fin above ventrals; teeth, inner row 5—4, without masticatory surface; mouth inferior; scales usual surface exposed. (TELESTES.)

Dorsal fin markedly behind ventrals; anal, basis elongate; teeth, inner row 5—5 without masticatory surface; mouth superior; scales usual surface exposed. (ALBURNUS.)

Dorsal fin over space between ventrals and anal; anal, basis elongate; teeth one-rowed, with masticatory surface, and crenate; usual surface scales exposed; mouth oblique; alimentary canal elongate. STILBE.

Dorsal fin behind ventrals; anal, basis short; teeth one-rowed, 5—5, 4—5, with masticatory surface; mouth straight or oblique; scales small, normal, lateral line interrupted or wanting; alimentary canal elongate. CHROSOMUS.

Dorsal fin behind ventrals; anal, basis short; teeth two-rowed, inner, 5—4, without masticatory surface; mouth oblique; scales minute, exposed as usual; lateral line interrupted or incomplete; alimentary canal short. PHOXINUS.

Dorsal fin little behind ventrals; anal short; pharyngeal teeth two-rowed, without masticatory surface, inner series 5—4; mouth large, oblique; scales usual surface exposed; lateral line complete. CLINOSTOMUS.

aa. Teeth of inner pharyngeal series 4—4 (often one-rowed). Alimentary canal not longer than head and body.

Dorsal fin over space between ventrals and anal; anal basis sometimes elongate; teeth two-rowed, not crenate, rarely with narrow masticatory surface; scales normal. ALBURNELLUS.

Dorsal fin over ventrals; anal, basis short; teeth two-rowed, without masticatory surface, smooth; scales normal; mouth oblique. PHOTOGENIS.

Dorsal fin over or a little behind ventrals; anal, basis short; teeth two-rowed, with masticatory surface, and sometimes slightly crenate; exposed portion of scales much narrowed, hence elevated; mouth oblique. HYPsILEPIS.

Dorsal fin over ventrals; anal, basis short; teeth one or two-rowed, with masticatory surface, smooth; scales large, normal; mouth small, inferior. HYBOPSIS.

GROUP III. No barbels; pharyngeal teeth sharp, hooked; alimentary canal shorter than body; dorsal fin with a strong elevated spine. MEDA.

Teeth 1, 4—4, 1; body scaleless.

GROUP IV. No barbels; pharyngeal teeth 4—4 only, cultriform, *i. e.*, with oblique masticatory surface, with no hook. First (bony) dorsal ray adherent to first articulated; labia attenuated; intestinal canal four times length. Labia without sheath; dorsal fin above ventrals; teeth one-rowed. HYBOGNATHUS.

GROUP V. No barbels; pharyngeal teeth one-rowed, 4—4, with masticatory surface, sometimes hooked; osseous dorsal ray separated from first articulated, by membrane; intestinal canal between two and three times length of head and body.

Lateral line continuous; head broad; mouth small, subinferior.

HYBORHYNCHUS.

Lateral line incomplete; head short, elevated; mouth small, inferior.

PIMEPHALES.

TRIBE IV. MESOCYSTI.

No barbels; pharyngeal teeth usually 4—4 only, with oblique masticatory surface and no hook; first (osseous) dorsal ray attached; labia with attenuated cartilaginous sheath; mouth inferior; alimentary canal six to nine times length head and body. CAMPOSTOMA.

Of the above, the species of *Semotilus*, *Ceraticichthys*, *Hypsilepis*, *Clinostomus*, *Campostoma*, *Hyborhynchus*, and *Pimephales*, develop in the male sex, during the breeding season, rows of spinous tubercles on the head; while the body is adorned with bright tints of red in *Argyreus*, *Clinostomus*, *Chrosomus*.

The following is the distribution of the species with reference to our three great water basins, so far as known:

OHIO.	SUSQUEHANNA.	DELAWARE.
	<i>Semotilus rhotheus</i> .	<i>Semotilus rhotheus</i> .
<i>Semotilus corporalis</i> .	<i>Semotilus corporalis</i> .	<i>Semotilus corporalis</i> .
	<i>Ceraticichthys micropogon</i> .	
<i>Ceraticichthys biguttatus</i> .	<i>Ceraticichthys biguttatus</i> .	
<i>Ceraticichthys dissimilis</i> .		
<i>Argyreus atronasus</i> .	<i>Argyreus atronasus</i> .	<i>Argyreus atronasus</i> .
	<i>Argyreus nasutus</i> .	<i>Argyreus nasutus</i> .
<i>Stilbe americana</i> .	<i>Stilbe americana</i> .	<i>Stilbe americana</i> .
<i>Hypsilepis cornutus</i> .	<i>Hypsilepis cornutus</i> .	<i>Hypsilepis cornutus</i> .

OHIO.	SUSQUEHANNA.	DELAWARE.
<i>Hypsilepis Kentukiensis.</i>	<i>Hypsilepis Kentukiensis.</i>	<i>Hypsilepis Kentukiensis.</i>
<i>Hypsilepis diplaemia.</i>		
<i>Clinostomus proriger.</i>		
<i>Clinostomus elongatum.</i>	<i>Clinostomus funduloides.</i>	<i>Clinostomus funduloides</i>
	<i>Clinostomus margarita.</i>	
<i>Photogenis leucops.</i>		<i>Hybopsis chalybaeus.</i>
	<i>Hybopsis proeue.</i>	<i>Hybopsis proeue.</i>
		<i>Hybopsis bifrenatus.</i>
	<i>Hybopsis hudsonius.</i>	<i>Hybopsis hudsonius.</i>
<i>Alburnellus rubrifrons.</i>		
<i>Chrosomus erythrogaster.</i>	<i>Chrosomus eos.</i>	
<i>Hyborhynchus notatus.</i>		
<i>Campostoma dubium.</i>		
<i>Ericymba buccata.</i>		
	<i>Exoglossum maxillingua.</i>	

The species inhabiting waters flowing into Lake Erie, are not determined. Among many occurring in the Ohio list above, may be selected with certainty *Stilbe americana*, *Hypsilepis cornutus*, and *Hyborhynchus notatus*; add *Hybopsis storerianus* and *H. hudsonius*.

It appears then that five species are common to all three river basins; that one species occurs in the Ohio and Susquehanna that is not found in the Delaware, and five species in the Delaware and Susquehanna, not occurring in the Ohio. Species as yet peculiar to the Ohio, ten; peculiar to the Susquehanna, four; peculiar to the Delaware, two. These figures will be more or less changed by future investigations.

In examining the pharyngeal teeth of the smaller Cyprinidæ, the student must be careful to observe the character of the masticatory surface. A lateral bevel of the edge of the tooth, sometimes somewhat obliquely turned, has much the appearance of such a surface to the unpractised eye; it however leaves the cutting edge of the tooth clearly marked. On the other hand, the masticatory surface constitutes a complete and usually broad truncation throughout the length of the portion, otherwise occupied by the edge. In young individuals of many genera, the edges of the teeth are serrate. This is persistent in the adults of the genus *Stilbe*, and of some species of *Hypsilepis*; in Europe it characterizes *Scardinius*.

It may be premised, that in the following descriptions the scales are counted from the origin of the first dorsal ray, to that of the ventral, never including those of the vertebral series.

The peculiarities of the Cyprinoid fauna of the Eastern district of North America, *i. e.*, from the Atlantic Ocean to the base of the Rocky Mountains, as compared with the Palæ-

arctic are, firstly, the existence of the three tribes Cochlobori, Cœlophori, and Mesocysti; as far as known the genera of the latter region, as well as those of the Palæotropical, are all referable to the tribe Epicysti.

As regards the Epicysti we observe, first, the absence of types related to the true *Cyprinus*, or to *Barbus*, the most bulky species of the family, as well as the smaller size in general of the American species, whether representative or peculiar; third, the abundant representation of the few species of *Gobio* and *Bungia*; fourth, the abundance of forms closely resembling the genera *Squalius* and *Idus*; fifth, abundance of forms intermediate between Cyprinidæ with soft lips, and those with cartilaginous labial sheaths; sixth, the paucity of representatives of *Abramis*, and over the Eastern part of the area, of *Alburnus*.

While, then, many of the genera of this district may be said to represent those of Europe, such appear to be separated by one prevalent ground of distinction, viz., the smaller number of teeth than in the European types. The inner series is commonly 6-5 or 5-5, sometimes 4-5 in the genera of the Old World;* in our Eastern district two genera rise to 5-5 and two to 4-5, while all the others possess 4-4, and many but a single row, which is unusual among European genera. In the Pacific region, the genera of Cyprinidæ, as of many other animals, repeat the European structure and bulk more nearly. In the following table the European genera are in italics; the representatives are opposite:

Inner series 5-5.	5-4.	4-4.
<i>Gobio</i> .	<i>Semotilus</i> .	Ceratichthys.
<i>Bungia</i> .		Argyreus.
<i>Stilbe</i> .		Platygobio.
<i>Abramis</i> .		
<i>Blicca</i> .		
<i>Bliccopsis</i> .		
<i>Pelecus</i> .		
<i>Alburnus</i> .	<i>Alburnus</i> .	<i>Alburnellus</i> .
		<i>Photogenis</i> .
<i>Aspius</i> .	<i>Clinostomus</i> .	
<i>Leucaspilus</i> .		
<i>Idus</i> .		
<i>Scardinius</i> .		<i>Cyprinella</i> .
<i>Leuciscus</i> .		<i>Hypsilepis</i> .
<i>Squalius</i> .	<i>Telestes</i> .	<i>Hybopsis</i> .
		<i>Codoma</i> .
		<i>Cochlognathus</i> .
		<i>Meda</i> .
	<i>Phoxinus</i> .	

* *Phoxinus* is rarely abnormally 4-4. Girard gives 5-5 in *Semotilus*, but I have not yet observed it.

Inner series 5-5.

Chrosomus.

Chondrostoma.

5-4.

Phoxinus.

Chrosomus.

4-4.

Hybognathus.

Hyborhynchus.

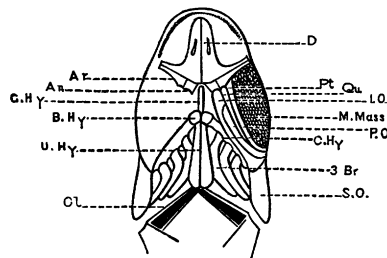
Pimephales.

Campostoma.

EXOGLOSSUM, *Rafinesque.*

Journ. Acad. Nat. Sci., Phila., I, 1818, 420.

D. Os dentale.
Ar. Articulare.
An. Angulare.
Pt. Pterygoideum.
Qu. Quadratum.
I. O. Interoperculare.
P. O. Præoperculare.
S. O. Suboperculare.



G. Hy. Os glossohyoideum.
B. Hy. Basihyoideum.
C. Hy. Ceratohyoideum.
U. Hy. Urohyoideum.
 3 *Br.* Rad. Branchiostegi.
Cl. Clavculus.
M. Mass. Musc. Masseter.

This genus was first properly defined by Professor Agassiz in his excellent review of the genera of American Cyprinidæ, in 1855, though he only explained the singular arrangement of the dentary bones by calling it "a projection of the symphysis of the branches" of the jaw, nor regarded its peculiarity as of so much weight as here indicated. Hence he placed it as affined to *Campostoma*. Girard, in his more extensive review (1856), correctly denies this relationship, and places it among the more ordinary types,—as *Alburnus*, &c. This approximation appears to me as erroneous as the last; in nature it has much of the manners of the *Campostomæ*, but not their habits, and the structure of the mandibular arch has no parallel among either series. I have therefore established for it a distinct tribe.

The series of pharyngeal teeth is situated chiefly on the inferior limb of the bone, the lower tooth being on a line with the angle of the lateral ala. The arched bones themselves are unusually small, and situated more within the scapular arch than in other genera.

The mandible is not margined by lips, nor covered with a cartilaginous sheath; the basal lobes are the rudiment of the former. The incompletely defined body which in this family represents the tongue is situated in the back part of the oral cavity, since the glossohyal bone is excluded from its usual place, and is short; its approximation to the intro-

percle and ceratohyal, with the basihyal and strong elongate urohyal, defend the lower surface of the head effectually.

This structure is obviously associated with the habits of the animal. The stomach usually contains abundant remains of Physæ, Pisidia, and other small mollusca, which form its food. The shovel-like mandible would appear to be adapted for removing these creatures from their hold on the rocks and bottom, while the great strength of the pharyngeal walls and muscles enables the fish to crush the shells before mastication with the pharyngeal teeth.

Besides the below-mentioned, Girard describes a species from Texas.

EXOGLOSSUM MAXILLINGUA, *Leseur.*

Cyprinus maxillingua, Leseur, Proc. Acad. Nat. Sciences, Phila., 1817, 85. *Exoglossum*, do., Haldeman, Rupp, Hist. Lancaster Co., Pa., 1844, 474, Agass., l. c., Girard, l. c.



Eye on the frontal plane, opening longitudinally oval, longest diameter $4\frac{1}{3}$ times in head, one and a half times in muzzle. A bony prominence at angle of preopercle and base of mandible; latter withdrawn into mouth when closed. Mouth slightly oblique, end maxilla not attaining line of orbit. Operculum higher than broad, convex below; the sub-operculum sickle-shaped, incurved; top of cranium broad, plane between nares; muzzle suddenly descending; interorbital breadth equal from end of mandible to margin of preopercle; scales, exposed portion higher than wide, radial grooves very numerous, and with the concentric ridges strong; 10-49-5; lateral line deflexed in front, median behind middle of dorsal fin. Head five times in total length or four and a quarter to base caudal; greatest depth five times to base of caudal. Caudal peduncle, depth $1\frac{1}{4}$ of greatest length. Back broad anteriorly, compressed at base of dorsal fin. Pectoral fin $\frac{2}{3}$ length to ventrals; latter to vent; basis of anal less than that of dorsal; height of anal $\frac{1}{4}$ th more than basis of dorsal, equal height of dorsal; outlines of both straight. Emargination of caudal, one-third its length.

Length of a fully grown individual 5.75 inches; end muzzle to first dorsal ray 2.57; same to origin caudal 2.44; first anal to same point 1.5; breadth between preopercula below .75. Color olivaceous, smoky above; a blackish band from pectoral fin to superior extremity of gill opening.

This fish is abundant in all the tributaries of the Susquehanna which have been examined, and is not known from other waters. In its movements it is sluggish; it keeps near the bottom in pools and channels of our clear rocky streams, not preferring rapids. It takes the hook very readily.

ERICYMBA, *Cope.*

Proceedings Acad. Nat. Sciences, Phila., 1865, 87.

This form appears to be related in structure to allied genera of the Cyprinidæ, as

Acerina is to some others among Percidæ. Its general appearance is that of a small Gobio or a Hybopsis, with the muzzle rather heavier than is usual in either; but examination shows that, besides the absence of barbels, it is peculiar in that the suborbital and interopercular bones, with the rami of the mandible, are greatly dilated, and bear septary laminæ, which separate mucus cavities, relatively as large as those of Acerina or Percopsis. They extend in two series; seven from the postorbital bone to the side of the end of the muzzle, and eight from the same point to the symphysis mandibuli. The muzzle overlaps the mandible; no cartilage on the latter. Scales large, the usual surface exposed. Anal short, originating opposite end of depressed dorsal. Origin of ventrals opposite first dorsal ray. Pharyngeal bones slender; teeth acutely uncinat-raptatory, without masticatory surface, 1.4—4.0.

I am not aware that any genus of Cyprinidæ exists in the Old World which possesses the cavernous structure above mentioned. Traces of it may be observed on the interoperculum in certain genera, *e. g.*, *Hypsilepis*.

The tooth series is situated entirely below opposite the alar angle of the pharyngeal bones, as in *Exoglossum*; in other genera the angle falls opposite the middle of the series. The length of the alimentary canal is less than that of head and body, and the natatory bladder extends throughout the whole length of the abdominal cavity.

ERICYMBA BUCCATA, *Cope*, loc. cit., Supr.

The suboperculum is small; operculum height to breadth as one and one-half to one. Head broad, muzzle obtusely rounded. Canthus of mouth opposite nares. Length of head contained three and five-sixths times to origin of caudal; greatest depth (at dorsal) nearly five times in the same. Caudal peduncle elongate, not constricted. Eye large, contained a little more than three times in length of head, a little more than frontal width. Origin of dorsal a little in advance of the point midway between end of muzzle and origin of caudal, its anterior ray equals half the distance from its base to anterior nostril. Caudal furcate one-half its length. Ventrals barely reaching vent; pectorals attaining ventrals. Scales $\frac{5}{8}$ 33; exposed portion with very numerous and delicate radii and concentric lines, not visible to the naked eye. A narrow space from vent to opposite middle of pectorals scaleless. Fins, DI. 8. C. +17+. A. I. 8. V. 8. P. 12. Lateral line nearly straight. Along and above it is a lateral band of brown punctulations; general color above yellowish olive, the edges of the scales dark-shaded, and a narrow brown vertebral line from nape to tail. Below lateral line silvery. Dorsal and caudal fins rosy. Length of a half-grown specimen, from muzzle to opercular edge 7 l.; to dorsal fin 13 l.; to end of appressed anal 1 in. 9 l.; to origin of caudal 2 in. 2 l.; to end of caudal 2 in. 8 l.



This species was originally known only from the Kiskiminitas, but Dr. Stimpson has taken it in abundance in the Muskingum, and William P. Clark, in the White River, Indiana, thus indicating an extensive distribution.

SEMOTILUS, *Rafinesque*.*Leucosomus*, Heckel and Girard.

This genus, with *Ceraticthys*, represents the European *Gobio*; fifteen species of the two former, with two of *Platygobio*, Gill, take the place in North America of the two known of the latter. The above synonyme was the result of an overlooking of the barbels, which are sometimes quite obscure. None of the species have the muzzle depressed or the mouth inferior as in the previous genus; this with the head, is obtuse and massive; the general form is deeper. The scales are large and present strong radii. Length of intestinal canal nearly equal that of head and body.

Lateral line originating below upper angle of operculum; scales large 45-7 in lateral line.

RHOTHEUS.

Lateral line origin at superior angle of operculum; scales smaller; l. l. 57-9; black spot at base of dorsal fin; eye 5 to 5½ times in head.

CORPORALIS.

Lateral line origin at superior margin operculum, scales smallest 9-63-5-7; elongate, muzzle long, eye one-sixth head; dark spot at base dorsal, no dark on sides, head, or body.

PALLIDUS.

SEMOTILUS RHOTHEUS, *Cope*.

Proc. Acad. Phila., 1861, 564, *S. corporalis*, Abbott, do. 1861, 154 (not *Cyprinus corporalis*, Mitchell). *Squalius hyalope*, Cope, *ibid.* 1864, 280.



This species and the next have a very broad preorbital bone, and the eye nearer the end of the muzzle than the opercular border. The posterior end of the margin of the operculum is above opposite the inferior margin of the orbit in both.

The *S. rhotheus* is the largest of our Cyprinidæ, reaching a length of eighteen inches. The dorsal line is arched and is continuous with the rather steep slope of the cranium to the labial border. Scales 8-45-7-5, a nearly equal portion exposed on the anterior and posterior parts of the body. The dermal sacs which hold them are black-margined, and extend beyond the tip of the preceding scale. Fins D I. 8. P. 17. V. 8 A. 8 C. 18. The head is broad, frontal width equalling one-half of superior length, muzzle rather short; the eye enters nearly twice into length of latter, and five times into that of the head. The head is one-fourth the length to the base of the caudal.

The colors of this species are particularly brilliant, having as ground a very pure silver white. The dorsal region is often steel-blue and the preopercular and subocular regions

bright roseate. In spring and summer adult males have longitudinal rosy lateral shades, and the dorsal and pectoral fins are crimson.

This chub is a most active and vigorous fish, and haunts especially rapids and falls,—the large individuals in the rivers and the smaller ones in the creeks and runs. It takes the hook without much play, and is good food, though not highly esteemed. When taken from the water it utters a chirruping and croaking noise, more like a voice than any sound heard from any other fresh-water fish of our region. Its food consists largely of “apple smellers,” *Gyrinidæ*. Its common name in Pennsylvania is “fall fish.”

Its habitat is the waters of the Susquehanna, Delaware, and other basins eastward to Massachusetts, where it is not common. It is much more abundant in Delaware than Susquehanna waters.

This species was first described by Abbott, who gives an account of the coloration of the male in spring. He identified it with the *corporalis* of Mitchell; the description of that species however applies equally well to the following, and the fact of its being stated to occur in river water (at Albany), and its western distribution, would refer it to the same. This view has been also taken by Putnam, who has published the synonymy given below, but was apparently not acquainted with the *S. rhotheus*.

Specimens of both *rhotheus* and *corporalis* of 2.5 inches and less in length do not possess barbels in many instances which have come under my notice; in such a condition they are not distinguishable on the usual basis, from the genus *Squalius*. Such a specimen I referred on a former occasion to that genus, along with others, which I am now able to separate.

SEMOTILUS CORPORALIS, *Mitchell*.

Cyprinus, Mitchell, American Monthly Magazine, ii, 324, and *C. atromaculatus*, Ibidem. *Semotilus dorsalis* et *cephalus*, Rafinesque, Ichthyologia Ohiensis. *Leuciscus Storeri* and *iris*, Cuv. Val.



This species is well distinguished from the last, as given in the table, as well as in the adult, by the narrowness of the exposed portion of the scales anteriorly as compared with that posteriorly, by the dark spot at the base of the dorsal fin, and darker colors above, in part caused by the exposure of the dark edges of the scale sacs. The pharyngeal teeth are shorter, and occupy a shorter basis on the bone.

Dorsal outline arched, descending steeply to labial margin; eye little less than one-fifth length of head; interorbital breadth one and three-fourths in length above. The relative width of the head differs slightly, some speci-

mens being more clumsy than the above; its length $3\frac{3}{4}$ in. total to origin caudal. Scales 9—47.9—6, DI. 7. P 17. V 8. A. 8., thirty on vertebral line in front of dorsal fin. Above blackish, scales above lateral line paler in the centre; below cream-colored; cheeks and opercle silver orange, a dark shade through eye. Dorsal fin in old males, red orange basally, except an anterior black spot. Length to end of caudal 9 in.; to base of do. 7 in. 8.5 lin.; to base of dorsal 4 in. 1.5 lin.; do. of ventral 4 in.

This species has not the vigor and beauty of the last, but is perhaps more active than the *Ceraticthys biguttatus*. It swarms in the smaller tributaries of the Susquehanna, where it continually takes the bait of the fisher for more valuable prey. As an article of food it is ordinary, but not to be rejected. It is less abundant in the Kiskiminitas, and Youghiogheny, tributaries of the Ohio, though not at all uncommon; nor is it more plentiful in the streams of the Delaware; outside the State, its distribution east of the Hudson is not known; it is characteristic of all the northern tributaries of the Mississippi to the upper waters of the Platte, and is common in the tributaries of the great Lakes. A diagnosis of the allied *S. pallidus*, Girard, from the Platte River, is introduced for comparison.

The *Semotilus corporalis* is known in Pennsylvania as the "Chub." Putnam first gave (in Bulletin Mus. Comp. Zool., Cambridge), its synonymy in full, which is entirely confirmed by my examinations of large series of specimens. The frontal and parietal width is greater in some specimens than others, and even in the relative length of the head to the body there is slight variation. In some young specimens there are no dark edges to the scale sacs, and occasionally (*e. g. ex.* from White River, Ia., *W. P. Clark*), the scales are nearly as much exposed anteriorly as posteriorly.

It is represented northeastwardly by the *Semotilus argenteus* (*Leucosomus pulchellus*, Gird.)

CERATICHTHYS, *Baird, Girard.*

? *Hybopsis*, Girard, Pt. Proc. Acad., Phila., 1856, 210. Girard, *l. c.*, 1856, 212. *Nocomis*, Girard, *l. c.*, 190.

This extensive genus embraces considerable variety of form and character, but forms an unbroken series from one extreme to the other. Indeed it cannot be said to be more heterogeneous than our present knowledge indicates to be the case with natural genera of much extent. The three subtypes are characterized in the table below; of these the third cannot be regarded as generically distinct from the second, as the first section unites in itself prominent features of the two.

In adults of the *C. cyclotis* m. (the Northwestern obtuse-headed representative of the *C. biguttatus*), the teeth are normally either 1.4—4.0 or 1.4—4.1; in half-grown specimens (eye one-fourth head) nearly always 1.4—4.1; in young specimens (eye $\frac{3}{5}$, in head) always 1.4—4.1; in the last stage they resemble very much certain *Hybopses* as

H. hæmaturus, where the form of the mouth and the squamation are about the same; the dentition is an infallible distinction. I have examined large numbers of individuals of both, from various parts of Michigan and Indiana.

Several species not yet detected in our State are introduced for comparison. Our species are distributed as follows:

<i>A. micropogon</i> ,	.	.	.	Susquehanna.
<i>A. biguttatus</i> ,	.	.	.	Ohio, Lake, and Susquehanna.
<i>A. dissimilis</i> ,	.	.	.	Ohio.

I. Mouth terminal; teeth 4.0—0.4 or 4.1—1.4; scales larger, radii stronger; isthmus medium.

Head short convex, end maxillary opposite eye, which enters length head $3\frac{1}{4}$ times; caudal peduncle slender; yellowish, a dark lateral and median dorsal band. MICROPOGON.

Head elongate, with muzzle slightly projecting, $4\frac{1}{2}$ times in length; outline arched from end muzzle, depth equal head; scales $\frac{7}{8}$ 40; teeth 1.4—4.1; dark band on muzzle and spot at base of tail. STIGMATICUS.*

Head obtuse, dorsal outline flat; height $4\frac{2}{3}$ length; lateral line nearly straight; eye $5\frac{1}{2}$ times in head; scales $\frac{7}{8}$ 41; teeth 1.4—4.1 or 0; caudal peduncle thick; olive above, yellowish below; operculum rounded above. CYCLOTIS.†

Head elongate, acuminate, dorsal outline flat, depth $4\frac{1}{2}$ length, eye 5— $5\frac{1}{2}$ times in head; caudal peduncle short; scales $\frac{3}{4}$ 40; teeth 4—4; operculum angulated above. BIGUTTATUS.

II. Mouth slightly inferior; teeth 0.4—4.0; scales larger; radii stronger; isthmus medium.

Slender, eye large, head one-fifth length; scales l. l. 49; dorsal fin larger than anal; a lead-blue lateral band. DISSIMILIS.

Slender, eye large, twice in length of muzzle; head one-fourth length; scales l. l. 70, dorsal smaller than anal. CATARACTÆ.‡

III. Mouth terminal, small; teeth 2.4—4.2; scales larger, concentric lines stronger; isthmus narrow.

Head one-fifth total length, depth body equal; eye one-fourth length of head; muzzle obtuse; scales 10-12—61-5—7-9; head and above blackish, a plumbeous band above lateral line, white below. PROSTHEMIUS.§

* *Ceratichthys stigmaticus*, Cope, Proc. A. N. Sci., Phila., 1864, 278, from Michigan.

† *Ceratichthys cyclois*, Cope, l. c., p. 278, from Michigan and Kansas.

‡ *Gobio cataractæ*, Cuv. Val., from Niagara. The pharyngeal teeth of this species are not described, but the inference from C. V., is that they are more as in *Gobio*.

§ *Ceratichthys prosthemi*, n. sp. nov.

This is a fish of the average size of *Semotilus corporalis*, but much more slender form; the outline is fusiform, the head being small and the muzzle broad and abruptly descending. Back compressed medially, first dorsal ray medial between end muzzle and origin caudal, considerably longer than first anal, its base longer than base of anal, ventrals opposite first dorsal ray, not reaching vent. End of maxillary not extending to opposite orbit; nares equally distant from each other and premaxillary margin.



The alimentary canal in the above species is nearly as long or as long as the head and body.

CERATICHTHYS MICROPOGON, *Cope*.

Proc. Acad., Phila., 1864, 277.



The appearance of the head of this fish is that of a *Hypsilepis* rather than of a chub, and the difficulty of discerning the minute barbels increases the liability to err in determining its affinities.

Mouth slightly oblique; angle opposite anterior border of orbit. Latter enters $3\frac{1}{4}$ times in length of head, which is measured $3\frac{3}{4}$ times in length from muzzle to base of tail. The greatest depth is measured $4\frac{1}{4}$ times in the same distance. Head broad, muzzle obtuse, profile rounded descending. Caudal peduncle long. Scales as in *C. biguttatus*, § 40. Teeth 4—4, without masticatory surface, the posterior considerably hooked. Length, from origin of tail to anterior base of dorsal equal from dorsal to posterior nostril. Rays, D. 1.8; C. 19; A. 1.7; V. 8; P. 13. Above pale yellowish-brown, with brown vertebral band; a broad brown shade from end of muzzle to base of tail; below pale yellowish. Length, 3 in. 6 lin.

Renewed examination confirms the normal distinctness of this singular fish. Were we disposed to adopt the hybridization hypothesis of Von Siebold, this species might be ascribed to the parentage of *Ceratichtys biguttatus* and *Hypsilepis cornutus*. On this question there are, however, no affirmative evidences extant.

I only know this species from a specimen sent me by my friend, Jacob Stauffer, of Lancaster. He took it in the Conestoga, a tributary of the Susquehanna. Whether it occurs in any of the other hydrographic basins is not yet known.

CERATICHTHYS BIGUTTATUS, *Kirtland*.

Boston Journ. Nat. Hist., iii, 1840, 344. *Ceratichtys*, Baird, Girard, Proc. Acad. Phila., 1856, 213.

The largest specimen of this species before me measures six and a half inches long.

Habitat. Lake Superior; specimens from the Montreal River, Keweenaw Pt., Lake Superior, from a fine collection made for the Academy, by our member, Dr. J. H. Slack. This species is quite peculiar in physiognomy in the genus. The *Gobio plumbeus*, Agass., has a much shorter head (one-fourth length) and smaller eye, and resembles more the *Semotilus* type. The stomach was filled with homopterous insects.

This is a stout species with a deep, compressed caudal peduncle, and large scales, of which an equal portion is exposed on the anterior and posterior parts of the body; number 6—40—4. The lateral line originates in a line with the superior margin of the operculum. Dorsal outline straight to above the nares, then the steep slope of the muzzle; the view of the orbit coincides with the plane of the vertex and is its own diameter above the horizontal line from the inferior posterior angle of the operculum. The eye is nearly equidistant between the end of the muzzle and the posterior margin of the operculum, giving it a physiognomy markedly different from that of the *S. corporalis* and *rhotheus*, and connected with an elongate parallelogramic form of the preopercular bone, D. I. 8. P. 15. V. 8. A. 7. C. 19. The head enters three and three-fourths times into the length to the origin of the caudal.



The general tint of this fish is brownish cream-colored, shaded with slate above the lateral line, where the scales are tipped and margined with the same. A dark postopercular crescent; operculum golden, with slate shades.

This fish abounds in all the streams in the State, except those emptying into the Delaware, in which I have never seen it. It is called the horned chub, from the numerous spinous tubercles which cover the vertex and muzzle in the breeding season; the nose of the males becomes at this time very much enlarged and convex, reminding one of the form of the profile of the Antelope saega, or of the Abyssinian sheep. In its movements there is but little activity, and it prefers pools and rock-shaded holes between the rapids of our mountain creeks. It is especially numerous in the streams tributary to the Ohio and the Lakes. It is not usually used as bait, as the fry only occur in the smaller streams, and the adult are of too large size.

CERATICHTHYS DISSIMILIS, *Kirtland*.

Leuciscus dissimilis, Kirtl., Journ. Boston Soc. Nat. Hist. *Ceratichtchys*, Cope, Proceed. Phila. Acad., 1864, 277.

The smallest and most slender species of the genus, near the form of *Gobio uranoscopus* of Europe. Eye margining the frontal plane, entering three and one-fifth times into length of head, and about one-quarter greater than interorbital breadth.



Length of head four and three-fifths times to concavity of caudal. Pectorals falcate, not reaching ventrals; latter falling short of vent. Anal with short base; front and inferior outlines equal. Caudal deeply furcate, with acute lobes. Upper outline of dorsal very oblique, longer than anterior. End of muzzle projecting beyond premaxillary border; end of maxillary beyond half way to edge of orbit. Scales 6—49—9, with 8 and 9 strong radii on the exposed surface. Greatest depth five and two-thirds times into length to notch of caudal. Rays D. I. 8. C. 20. A. 7. V. 8.

In coloration this pretty fish rather resembles a *Hybopsis*, or more the *Gobio fluviatilis*. It is generally silvery, with a broad plumbeous blue band following the lateral line, which is irregularly deeper and paler in some smaller specimens. A blackish band from end muzzle to orbit.

This is one of the species of "minnows" which are used by the fishermen as bait for Bass (*Micropterus*) and Catfish. It is a river species and has not the vivacity of the *Argyreus*. I have seen it from the Monongahela and Youghiogheny Rivers; it occurs also in the Mahoning, according to Prof. Kirtland. It is not found in any of the other water basins of the State.

ARGYREUS, *Heckel*.

Fische Syriens, 1842, 50, Girard, Proc. Acad. N. S., Phila., 1856, 185. *Rhinichthys*, Agassiz, -Amer. Journ. Sci. Arts, 1854, 357.

This genus only differs from the last in the non-projectility of the premaxillary apparatus, and the non-continuance of the postmaxillary dermal fold over the muzzle. Alimentary canal rather shorter than length of head and body. So far as known the species are of smaller size than the preceding, and have smaller scales; they are adorned with brilliant hues during the spring and summer, to a far greater extent. In Europe, the *Gobio uranoscopus*, Agass., has a physiognomy slightly like some of the *Argyreus*.

Mouth entirely inferior; teeth 2.4—4.2; scales smaller, concentric, lines stronger; isthmus wide; pectoral fins inferior, horizontal, not capable of application vertically to the sides. Head $4\frac{1}{2}$ times in total length. Eye one-fifth length of head; muzzle elongate, narrowed; twelve rows of scales on caudal peduncle. No black lateral band.

NASUTUS.

Head four times in total length; muzzle broad, short; eye less than four times in head's length; 8—10 rows of scales on caudal peduncle; a black lateral band; scales l. l.

ATRONASUS.

ARGYREUS ATRONASUS, *Mitchell*.

Heckel Fische Syriens, 1842, Girard, Proc. A. N. S., Phila., 1856. *Rhinichthys atronasus*, Agassiz, Am. Journ. Sci. Arts, 1854.

The smaller of our species. As in the *nasutus*, there are about twenty longitudinal rows of scales between the dorsal and ventral fins. In summer and autumn it is brownish olive above a black band which extends round the nose to the origin of the caudal fin on each side, and satin-white below it. In spring the latter region becomes vermilion red, and the lateral band assumes an orange hue; the pectoral and ventral fins become similar to the abdomen, and the rays of the former are greatly thickened. The brilliant coloring

matter, as has been shown by Prof. Peters, is deposited in little sacs of the derm (chromatophoræ); these may be made to disclose their crimson contents by means of a sharp instrument, some time after the fish appears to have lost his livery. The strengthening of the pectoral rays is appropriate to the increased exertion incident to the impregnation of the eggs. Later in the season the brilliant crimson gives place to orange, which fades to golden; this may often be seen in specimens caught as late as the end of summer, when many have resumed their silver white.

This species is abundant in the rivulets tributary to the three great rivers that drain our State. A Northwestern representative, the *R. lunatus*, will perhaps be found also within our limits.

Argyreus atronasus is a favorite for aquaria, and is generally sold as the "black-nosed dace."

ARGYREUS NASUTUS, *Ayres*.

Boston Journ. Nat. Hist., Girard. Proc. Acad., Phila., l. c., 1856.

Rhinichthys, Agassiz. *Chondrostoma*, Heckel, Fische Syriens.



This is a larger and more elongate species than the last, with a most prominent and flattened muzzle.

It is of a general olivaceous color, paler below, with numerous brown punctulations, sometimes extending over the sides of the belly, and almost blackening the upper surfaces, and in young specimens accumulated near the lateral line. There is never seen the lateral band of the *atrnasus*, and the space between the orbit and muzzle is blackish like the top of the muzzle and front. There is a black spot on the operculum. In spring the lips and parts of cheek of the males, with the paired fins and the caudal, are of a bright crimson. The pectorals of both sexes are lanceolate, but as in the last species, the males have the rays much enlarged; these fins are absolutely longer in this sex, attaining the ventrals, while in the females they reach only two-thirds that distance. Radial formula as in the preceding species, D. I. 8, A. I. 7, P. 15. Lateral commencing at top of operculum, decurved; scales in a Delaware specimen 14—65—8, in two Susquehanna, 12—57—7-8; the latter were rather smaller.

This species is less abundant than the last, and appears to be rather local in Eastern Pennsylvania; it prefers boisterous and rocky streams, in whose rapids and ripples it may be seen in twos and threes, and will sometimes take the hook with the spring and energy of a trout. I have taken this fish several times in the tributaries of White Clay Creek, Chester County, and have it from the neighborhood of Safe Harbor, Lancaster County, on the Susquehanna. The latter specimens are almost black above and on the sides. It is not known to occur in any tributaries of the Ohio.

I have found a species of Entomostracous crustacean, an *Argulus*, parasitic on this species, attached within the nareal cavity, and spread round its margin externally. J.

Stauffer has also found numerous Arguli attached to the branchiæ of an *Amiurus albidus*, which was in an exhausted condition.

HYPSILEPIS, *Baird*.

Plargyrus, Rafinesque, Girard, Proc. A. N. S., Phil., 1856, 195.

Mouth small, terminal; pharyngeal teeth acuminate, with moderate masticatory surface, 2.4—4.2. Anal fin short; scales moderate, extensively imbricate, leaving a small surface exposed.

This genus resembles both *Leuciscus* and *Clinostomus*, partaking of features of both, besides having those peculiar. It is distributed throughout the eastern district of the United States, and extensively in the central district, that is, to the Rocky Mountains. *H. plargyrus*, not included in this synopsis, may yet be found in the Alleghany River.

One of our species has been referred to the genus *Cyprinella*,* Girard, but it presents all the characters of *Hypsilepis*. The former genus is said only to differ from the latter in the crenulation of the edges of the teeth, and this indeed is visible in many specimens of the *Hypsilepis kentukiensis*, but not always, and frequently on one tooth only.

Dr. Girard, however, describes his genus as being furnished with dental serrations of an acute edge, without masticatory surface, and with a dorsal fin situated posterior to the line of the ventrals. The latter holds good to such a trifling degree in the *H. kentukiensis* as to be of little significance, and either this species is not properly *Cyprinella*, or the latter genus has no existence.

Our three species may be distinguished as follows:

Head 4—4½ times in length to origin caudal; scales 5—6, 35—40—3; teeth more or less crenate, outer row 1—1; muzzle more acuminate; black spot on dorsal fin behind.

KENTUKIENSIS.

Head 4½ times in length, muzzle more obtuse; scales 8—41—3; teeth never crenated, outer row 2—2; no black spot on dorsal fin.

CORNUTUS.

Muzzle plane above, mouth descending; orbit 3.5 in head; tubercles minute; scales 9—44—3; anal 10½; dark above, reddish below, base of dorsal black.

DIPLEMIA.

* Proc. Acad. Nat. Sci., Phila., 1856, 196. *Moniana*, Ibidem, 199. This genus, if such it be, is chiefly diffused south and west of the Mississippi.

HYPHILEPIS KENTUKIENSIS, *Rafinesque*.

Leuciscus Kentukiensis, Kirt., Bost. Journ. Soc. Nat. Hist., 1845, 27.

Cyprinella do., Cope, Proc. Acad., Phila., 1854, 279.

Cyprinella analostana, Girard, Proc. Acad., Phila., 1859, 58; Cope, l. c.



The dorsal and ventral outlines are regularly and gently arched from the end of the muzzle and contract to a caudal peduncle of about the depth of the head at the middle of the orbit. The dorsal region is quite compressed, the ventral narrow but not carinate in front of the vent. Eye round, contained 4.5 times in length of head, and 1.5 in length of muzzle; the latter is narrow and projects slightly beyond the mouth, most so in males in breeding season. Oral margin arched, end of maxilla opposite middle of nares. The greatest depth of the body is greater than the length of the head, and enters the total (including caudal fin) four and one-fifth times. Tail short, deeply and concavely emarginate. Anal fin less developed than dorsal, its base nearly equal height of first ray, and just exceeding base of dorsal; latter a little over two-thirds greatest elevation of the same.

General color leaden silvery, darkest on the sides; the scales above and below, a dorsal band and large spot on hinder part of dorsal fin, blackish; top of head and median margin of anal fin shaded with the same. In spring and summer the inferior fins, and even the tip of the caudal, and anterior part of the dorsal, are filled with a satin-white pigment, which has a very elegant effect, and gives the fish its local name of "Silver Fin." At the same period the head and muzzle of the male are studded with small tubercles, as follows: a conic accumulation on the end of the muzzle, prolonging it; a series round the mandible, also over the orbit from an agglomeration on the preorbital bone; a double series of larger tubercles on each side the frontal region, which join between the nares and on the parietal region; scattered series on the temporal region.

Total length 3.375 inches; caudal .5; from its base to first ray of anal 1 in.; to first dorsal ray 1.44 in.; from latter to end of muzzle 1.56.

This species is abundant in the various tributaries of the Ohio; it is also common in all the waters of the Susquehanna examined (Octorara, Conestoga, Juniata, Meshopen), and in the Potomac (Girard); from the Delaware I know it from the neighborhood of Trenton (C. C. Abbott), and Philadelphia (J. Burk), and Conshohocken, on the Schuylkill. During the seventh month of the present year I watched a company of them, with a greater number of the *Hybopsis procne*, clearing out with pectoral fins and muzzle, a sandy basin between two roots of a stump standing in the Conestoga Creek. They were excessively active, suddenly turning from their employment and sailing off in streaming columns, when the silver-white of their fins had a pleasing and peculiar effect in the evening light. As we approached, a *Tropidonotus sipedo* swam off with a luckless *Hybopsis* across his mouth, but soon returned to watch alternately ourselves, and the busy throng. Approaching cautiously, he struck right and left below the surface, as the minnows passed him, but often fell short, till a hungry *Aromochelys odoratus*, having the haste and move-

ments of a half-fed hog, came nosing his way into the midst of the unsuspecting party. They of course scattered in all directions, while he hastily explored the ground, and finding no eggs, scuttled off with the wampum snake. The latter returned, and was successfully pursuing his fishing when we left.

Dr. Girard described specimens of this species from the Potomac, as distinct from those of the Ohio, without making comparisons; I undertook to substantiate the differences, and give the following as distinctive features of the Eastern and Western fishes:

Head three and two-thirds to four times in length to base of tail. Scales $\frac{5-(6)}{2-(3)}32-5$. for the Eastern.

Head four and one-third times; muzzle more acute. Scales $\frac{6-7}{3-4}38-40$. for the Ohio type.

These represent the tendencies of the individuals of these regions correctly, but the exceptions to the rule are not rare; thus a Schuylkill specimen before me exhibits a head four and one-third times in length and has an acute muzzle, scales of lateral line 38. Seven rows of scales above the lateral lines in a Youghiogheny specimen include some abnormally intercalated, but not a true series; about half the Delaware specimens exhibit six. Four rows below the lateral line has resulted from counting an elevated abdominal series. In two Ohio specimens the anal radial formula is identical with that of the Eastern, 1.9, while in five the formula is 1.8. Thus this species exhibits an unusual range of variation.

HYPsILEPIS CORNUTUS, *Mitchell*.



Hypsilepis, Baird, Storer, Mem. Amer. Acad., v, 1855, 118. *Platygyrus cornutus*, Girard, Proc. Phila. A. N. S., 1856, 196. Fig. Storer, Trans. Amer. Acad. Arts and Sciences, 1855, t. xxi, fig. 3.

Dorsal region convex and compressed to dorsal fin, with sixteen to nineteen scales in the vertebral series; head four and one-quarter times in length to base of caudal fin, and four-fifths of greatest depth of body; vertex concave, muzzle obtuse rounded; mouth terminal, end of maxillary terminating opposite posterior nostril. From end muzzle to dorsal (first ray) seven-eighths from latter to origin of caudal. Ventrals origin exactly under first dorsal, broadly truncate, not quite attaining vent. Base of anal nearly equal its anterior ray, outline slightly concave. Base of dorsal two-thirds height anteriorly. Pectoral anterior rays shortened, medial not quite reaching the ventral. Operculum one-third higher than long. Eye, diameter one-fourth length of head, and once below its rim to upper preopercular ridge. Frontal width one-half length head above. Scales 8—41—3, about twenty-three on the dorsal line in front of dorsal fin. Radial formula D 1. 8; C. 4. 19.5. A. 1.9. V. 8; P. 1.15.

Coloration of an adult male: dorsal region as far down as the fourth row of scales dark impure blue, divided by an indistinct band of yellowish olive, one and a half scales wide, which follows the outline of the back; bordering the

dark below is a luminous line which does not attain the tail, which is very visible in the water, and from above when wet and out of water. Sides from rosy to silver-white, the scales in adults blackish at bases. Anal, ventral, and pectoral fins bright crimson in spring and summer, in males. Operculum rosy, head dark above. The males in spring have the branchiostegal membranes and the chin bright crimson.

Total average length 5 in. 7 lin.; head 1 in. 1 lin.; end muzzle to base anal 3 in.; depth at dorsal 1 in. 4 lin.; at anal 11.5 lin.

The above description is taken from an adult from the Conestoga, Lancaster County. Many Susquehanna specimens exhibit a more elongate form of head and body than specimens from the tributaries of the Delaware. They often differ from those of the Susquehanna in having a row of scales or two more below the lateral line. In Delaware specimens the head is shorter than in the latter, not more so than in the former, but the depth of the body is greater than in either, entering in length to base of tail three and one-third times; in the others four and four and one-third times. The dorsal fin is a little more anteriorly situated in the Delaware specimens, and there is a row of scales more below the lateral line than in Susquehanna specimens. With typical specimens only, these might be regarded as representing two species, and as such I have already alluded to them; but in the large number of individuals at my disposal, I find transitions in all the points. The Delaware specimens more nearly resemble the *H. cornutus*, figured by Dr. Storer.

This is one of the most widely distributed of our Cyprinidæ, occurring from New England through the Middle and Western States to beyond the Mississippi. In the waters of the Susquehanna and Delaware basins it is, with the *Argyreus atronasmus*, the most abundant species. It prefers clear waters and does not haunt rapids.

The best figure of this, as well as of some of our other Cyprinidæ, is given by Dr. Storer in his excellent Monograph on the fishes of Massachusetts.

HYPSILEPIS DIPLÆMIA, Raf.

Leuciscus diplæmia, Raf., *Ichthyologia Ohiensis*, 50. *Luxilus* do., Kirtland, Bost. Journ., N. H., 1845, 276. *Tab. Plargyrus* do., Girard, Proc. Acad., Phila., 1856. *Hypsilepis* do., Cope, l. c., 1864.

This species has somewhat the form, as it has the coloration and minute nuptial excrescences, of the species of *Clinostomus*; as in them the dorsal fin commences slightly behind above the origin of the ventrals; its hinder margin is opposite the origin of the anal, to which the ventrals attain. Anal elongate, its last ray horizontal, outline behind, vertical concave. Dorsal elevated, rounded above, length of first articulated ray one-half from its base to base of caudal. Radial formula D. 1.9 P. 12. V. 8. A. 1.11. C. +18+. Dorsal outline elevated, superior line of cranium scarcely arched, head rather compressed; body rapidly narrowing to caudal peduncle at dorsal and anal fins. Caudal expanded deeply emarginate.

In the breeding season minute asperities cover the dorsal line in front of the dorsal fin, and appear on the upper and lower aspects of the head. The latter are most abundant on the preorbital region; on frontal region sparse minute. Rows on the superciliary and lower edge of suborbital regions, and two on each ramus mandibuli. Length of head four times in length to base caudal, and less than depth of body. Scales of anterior dorsal region much smaller than those of the lateral; latter with exposed surfaces very narrow, and crested with minute tubercles in the breeding season.

Color, dusky above, the sides and belly silvery, without band; below crimson in spring. A large black spot at base of dorsal fin. Length extends to four inches, according to Prof. Kirtland; of a specimen in Museum Academy, from Lansing, Michigan, 2 inches to origin caudal; 12.5 lines to origin dorsal; 6 lines to opercular margin; depth 7 lines.

I introduce this species on the authority of Prof. Kirtland, who states that it is abundant in all Western streams, and that it ascends rapids in shoals in spring, for the purpose of depositing its eggs.

CLINOSTOMUS, *Girard*.

Proc. Acad., Phila., 1856, 211.

As originally defined, the group bearing this name was not distinguishable from *Squalius* of Europe, with which I accordingly connected it. The elimination of some of Girard's characters leaves, however, a natural genus for which his name may be retained. It is represented in Pennsylvania by four species, one of which has not yet fallen under my observation. They are the most brilliantly-colored Cyprinidæ of this or any other country.

The characters of the genus as here understood, have been already given. It differs from *Phoxinus* principally in the large oblique mouth and prominent mandible, and the complete lateral line. The scales exhibit strong concentric ridges, and the lateral line is often much decurved, as in *Stilbe*.

The *Phoxinus lævis* is common in every stream in Middle Europe, much as *Argyreus atronasmus* is here. It is ornamented with brilliant colors during spring. The present species are much less abundant, and are distinguished by the much larger size of their scales.

A nearer ally of the European fish exists in our country, however, than has been suspected, in a species of the same genus. This, our *Phoxinus neogaeus*, has not been detected in Pennsylvania, but was procured during the zoological survey of Michigan, on the ichthyology of which a report was published in the Proceedings of the Academy for 1864. Its slightly oblique mouth indicates affinity with *Clinostomus*. As these species bear considerable external resemblance to those of *Chrosomus*, they may be superficially compared thus:

Clinostomus margarita. Scales largest, head shortest, no dark lateral band.

Phoxinus neogaeus.^{*} Scales small, head short, lateral line half-way to dorsal; a dark lateral band from muzzle to caudal.

Chrosomus erythrogaster. Scales smallest, head elongate, muzzle prominent, lateral line short; two dark-colored lateral bands from orbit to caudal, separated by a silver band; unicolor.

Chrosomus eos. Scales smaller, head moderate, mouth shortest, muzzle not prominent; one dark band from orbit to caudal, without silver band on caudal peduncle; back spotted.

The species of *Clinostomus* known to the author are the following:

a. Eye small, one-fourth length of head.

Posterior opercular angle less than right; mandible compressed, much projecting; scales 10—62—5.

PRORIGER.

aa. Eye larger, one-third length of head.

Posterior opercular angle right or larger; mandible not compressed, scarcely prolonged; scales 9—46—50—4; muzzle acuminate, muzzle reaching line of pupil; a light and dark lateral band.

FUNDULOIDES.

Posterior opercular angle right; mandible not compressed; muzzle obtuse; maxilla not reaching line of orbit; scales 11—58—8-9; no dark lateral band.

MARGARITA.

In the *C. margarita* and *C. funduloides* the edges of the pharyngeal teeth are frequently hyaline and sometimes so obtuse as to give an erroneous impression of a grinding surface.

CLINOSTOMUS PRORIGER, Cope.

Squalius proriger, Cope, Proc. Acad. Nat. Sci., 1864, 280.

In this Cyprinoid the prolongation of the lower jaw is very great: it presents a symphysial knob beyond and above the premaxillary border. End of the maxillary opposite the middle of the pupil. Angle of opercular outline less than 90°. Head narrowed anteriorly; eye four times in its length: latter four times in length to concavity of tail. Greatest height $5\frac{1}{4}$ times in the same. Ventrals a little in advance of dorsal: from front base of

* *Phoxinus neogaeus*, Cope. *Chrosomus eos*, m. Proc. Acad. Nat. Sci., Phila., 1864, 281 (not 1861, 523).

Head more than one-fourth length to base of caudal. Parietal region broader, width one-third from first dorsal ray to caudal, which equals from dorsal to posterior margin of orbit. Muzzle short, mouth oblique, reaching edge of orbit. Scales above lateral line 18 rows, transverse series 77, longitudinal 30. Greatest depth of body, enters length to basis of caudal a little over four times. Eye contained three and a half times in length of head, diameter greater than length of muzzle from its anterior rim. Radial formula D. 8, C. 18, A. 8, V. 8, P. 16. Lateral line crossed twenty-four rows of scales. A blackish band along the lateral line, above this yellowish-brown, lighter next the band; back unspotted. A dark spot at base of tail; suborbital and opercular regions with a bluish reflection. Teeth 2.5—4.2.

Total length 2.75; length caudal .5; base of latter to origin first dorsal ray 1; from latter to end of muzzle 1.25. The pectoral extends about half way to ventrals; latter not to vent; dorsal and anal small.

This species differs from *Ph. lævis* by its scaly vertebral and ventral regions, and much shorter lateral line.

Specimens from New Hudson, Livingston County, Michigan.

latter to base of tail equal from former point to half way between end of muzzle and nares. Scales small, with especially strong concentric lines, 10—62—5. Dorsal high 1.8; caudal deeply furcate, 19; anal rather elongate, 1.8½. V. 8, not reaching vent; P. 14, elongate. Total length three inches, large specimens four and a half inches.

In spirits, rufus brown above half way to the lateral line; a dark shade from end of muzzle to tail, covered with silvery, the latter extending to the belly. Sides punctulate anteriorly.

In spring and summer the belly and sides to above the lateral line are of a bright crimson. Teeth in two specimens 2.5—4.1.

This species occurs in some of the tributaries of the Ohio, and has not been seen in any of the waters more eastwardly. It has apparently been formerly not distinguished properly from the *C. elongatus* of Dr. Kirtland, unless it be the *Leuciscus productus* of Dr. Storer. Kirtland's description applies equally well to both species, while his figure does not represent the proriger. I have seen several specimens of the *C. elongatum*, which exhibits a shorter head and jaw than the present fish, but have none at hand from which to draw a description. It occurs in some Western States, and probably also in Western Pennsylvania.

CLINOSTOMUS FUNDULOIDES, Girard.

Proc. Acad. Nat. Sciences, Phila., 1856, 212.



Orbit one-third head, which is equal greatest depth, and one-fifth length, including caudal. Mandible projecting beyond premaxillary; maxillary extending to opposite pupil. Posterior angle of operculum right. Caudal fin rather elongate; its furcation one-third its depth. Anterior dorsal rays two and one-fifth times in length from their basis to that of caudal; longest anals two and one-half the same distance. Dorsal outline arched to first dorsal ray; caudal peduncle rather narrow, its depth three and one-quarter times from median base of caudal to first anal ray. The operculum is considerably longer than high; the orbit round, as long as the muzzle in advance of it, and nearly equal the interorbital width. Dorsal and anal fins with short basis and long rays, latter nearly as long as former; basis of dorsal half its longest rays; a little more than half same in anal fin, ventrals reaching anal and pectorals ventrals. A male in breeding dress is quite rugose, like the *Hypsilepis diplæmia*, with tubercular points on the back and sides, and the rays of the dorsal and anal fins. The thoracic and branchiostegal regions, with the lower part of the operculum, are thickly studded, and on the top of the head they are of equal size and irregularly arranged to about six in transverse directions. The fissure of the mouth is large, the end of the maxillary opposite the anterior rim of the pupil. The lateral line is more strongly decurved in this species than the last, and rises distinctly opposite the origin of the ventrals.

Above dusky to the lateral line, with a light (? yellow or red) band from the superior opercular angle, above the lateral line to the tail. Below lateral line, chin, suborbital, and subopercular region yellowish; red in spring. Dentition 2.5—4.2.

I have several specimens of this handsome species from the Octoraro, a fine tributary of the Susquehanna, which separates Chester and Lancaster Counties. I have also seen a specimen from the White Clay Creek, in Chester County, tributary of the Delaware,

which is preserved in the museum of my friend Vincent Barnard, of Kennett Square. This is the best local collection of the vertebrata of our section with which I am acquainted. Few regions can boast of more numerous and beautiful streams than Southeastern Pennsylvania, there being no less than nine, omitting several of minor size, between the Schuylkill and Susquehanna Rivers. The wanderer on their banks traverses alternately the forests of numerous species of *Quercus*, *Carya*, and *Fraxinus*, with tangled underbrush of *Kalmia* and *Smilax*, the cultivated fields, and the jungles of *Asclepias*, *Eupatorium*, *Cassia*, and *Rudbeckia*, gorgeous with red and gold.

The Susquehanna tributaries yield the greater variety of species and number of individuals to the ichthyologist. In the rocky beds of the Octorara and Elk, gaudy shoals of this active species and the *Hypsilepis* contrast with the dusky *Exoglossum* and the solitary stone catfish (*Noturus*), which love concealment, and are only seen when disturbed, darting from stone to stone. These streams have not been so obstructed by dams as most others, where the erection of vertical breasts near their mouths has almost completely deprived them of their anadromous species of fish. The destruction of the shad fishery in the Susquehanna was a result of this shortsighted practice; as the interest was large, the legislature finally interfered, and the dam was removed, and similar obstructions in the tributaries of this river directed to be taken away. Reckless destruction of fish in the tributaries of the Alleghany has resulted in a strict enforcement of the game laws, but neither protection has yet been actively applied to the Delaware tributaries.

The building of oblique breasts to the dams would enable numerous species to pass up which are now prevented, and the harmony of nature would remain undisturbed, greater purity of the water insured, and no mean source of food preserved and developed.

CLINOSTOMUS MARGARITA, *Cope*.

The muzzle obtuse, mouth oblique, scarcely attaining the line of the anterior margin of the orbit. Head four times in body to base of caudal fin, equal the greatest depth. Eye three-fourths its diameter from end of muzzle, and equal postero-inferior margin of operculum. Scales less exposed on anterior than posterior regions, and covering the inferior regions; 11—58—8-9. The lateral line is discontinued 5-8 scales anterior to the caudal fin. Pharyngeal teeth slender 2.5—4.2. Dorsal originating behind origin of ventrals, 1.8. C. 19. A. 1.8. V. 8, extending three-fourths from their origin to the anus; P. 17, reaching two-thirds way to ventrals.

From origin caudal to that of first dorsal ray 12 l.; from latter to opposite posterior margin orbit, 9.5 l.; from same to end muzzle, 13.5 l.; base first anal ray to base of caudal, 8 l.; end muzzle to base ventrals, 12 l.; total length 2 in. 6 lin.

Coloration, above light olive, without dorsal line, but darker shade at origin dorsal fin, with a minute slaty dusting, and a few lateral speckles of the same. Sides to half way above the lateral line with opercula, plumbeous silvery; below bright crimson (in midsummer) to lower margins of pectoral and ventral fins; median line below, straw-colored. Muzzle blackish; fins unspotted.



I have only seen this fish from a tributary of the Conestoga, near Lancaster, Pennsylvania, which it inhabited with *Argyreus*, *Semotilus*, etc.

PHOTOGENIS, *Cope*.

This genus is the ally of *Hybopsis*, from which it differs in the sharp-edged pharyngeal teeth, which contrast with the marked masticatory dentition of the latter. The mandible is projecting and the mouth oblique, while in *Hybopsis* the mouth is usually horizontal or slightly inferior; in *H. hæmaturus*, however, it is terminal, and in *H. heterodon* and *H. plumbeolus* (*Alburnops*, m. l. c., 282) oblique, and the under jaw slightly projecting. It is therefore probable that further investigation will be necessary to establish this, as well as the allied genera, on firmer bases, though their recognition is not difficult with present material.

Scales 5—39—3; depth one-sixth length to base of caudal; equal from muzzle to preopercle; ventrals far short of anus; dorsal immaculate, a lateral satin band; lateral line little decurved. LEUCOPS.

Scales 7—35—3; depth four and three-quarters to base of caudal, equal from muzzle to front of opercle; ventrals not to anus; dorsal fin unspotted; sides and below silvery; lateral line much decurved. ARIOMMUS.*

Scales 6—38—2; depth one-fifth length to base of caudal, equal from muzzle to middle opercle; ventrals to anus; dorsal with black spot behind; no lateral satin band. SPILOPTERUS.†

* *Photogenis ariommus*, *Cope*, sp. nov.

This species resembles at first sight the *Ph. leucops*, but is less *Alburnus*-like. On comparing with an example of the latter, .25 longer, the depth of the body is the same, and the eye strikingly larger; the depth of the head the same, and the muzzle shorter.

In this fish the operculum is deeply concave on its upper posterior margin, and the inferior is shorter than the anterior; in *P. leucops* the former is straight, and the inferior border equal the anterior. The dark lateral line is faint or wanting in the *ariommus*, and there is no black vertebral band. Placed alongside of a *Hypsilepis cornutus* of equal length, this fish is less deep, and has an eye of almost double the area, besides the different coloration and generic features of teeth and scales.

Eye two and three-fifths in length head; muzzle two-thirds its diameter; mouth large, mandible scarcely projecting, maxilla not attaining anterior margin of orbit. Frontal breadth three-fifths orbit. Pectoral fins reaching three-quarters distance to ventrals. Depth caudal peduncle one-third from middle origin caudal to opposite first anal ray. Basis of anal slightly elongate, four-fifths height of same, equal basis dorsal; latter equal two-thirds height of dorsal; last dorsal ray much less than half first, hence the outline of the fin is very oblique. Caudal deeply furcate, length equal that of head.

Light olivaceous sides and below silvery, becoming a band with superior dark edge on caudal peduncle. Sides of head and muzzle white. Total length 2.875 inches; base of dorsal to superior base caudal 1.06 inches; same to end muzzle 1.19.

† *Photogenis spilopterus*, *Cope*, sp. nov.

PHOTOGENIS LEUCOPS, *Cope*.

Squalius (Clinostomus) photogenis, Cope, Proc. Acad. Nat. Sci., Phila., 1864, 280.

A species resembling some *Alburni* in its large caducous scales and attenuated form. Eye one-third head, round. Mouth quite oblique; under jaw scarcely projecting; maxillary not reaching line of margin of orbit. Head entering four and two-thirds times into length to fork of caudal; greatest depth seven times. Back broad. Fins D. narrow 8; C. 19, A. 1—10. V. little anterior to dorsal 9. P. narrow falcate 13, extending about half way from their origin to that of the ventrals. Scales with radii stronger than concentric lines. From base of caudal to base of first dorsal ray, equal from latter to anterior border of iris. Lateral line deflexed, rising with outline of belly at anal fin. Above pale ochre, with a median brown line, and one on each side, from opercular upper angle to tail. Sides and below bright silvery, especially brilliant on the operculum and suborbital region. Lips blackish edged. Muzzle and chin whitish. Length three inches.



In two specimens the pharyngeal teeth are arranged 1.4—4.1. This bright species occurs, so far as known, in tributaries of the Alleghany River only; those which we possess are from the Youghiogeny.

It is readily distinguished among our numerous small silvery species, resembling in a slight degree only the *Alburnellus rubrifrons*. This has a shorter, deeper body, longer muzzle, smaller eye, etc.

HYBOPSIS, *Agassiz*.

Amer. Journ. Sci. Arts, 1854, 358. Putnam Bullet. Mus. Comp. Zool., No. I, p. 9. *Hudsonius*, Girard, Proc. A. N. Sci., Phila., 1856, 210. *Alburnops*, Girard, l. c., 194.

Form elongate, less so than in the *Ph. leucops*; scales with the radii distinct 6—10, and the concentric lines very strong. Lateral line deflexed anteriorly. Orbit three and one-half times in length of head, equal length muzzle, and is three-fourths the interorbital breadth. Head five and one-third times in total length, equal length caudal fin. Muzzle straight above, mandible not projecting when closed, end of maxillary attaining line of orbit. Premaxillary margin opposite middle pupil. Pectorals two-thirds length to ventrals. Bases of anal and dorsal fins equal, equal two-thirds height of former, three-fifths height of latter. First dorsal ray a little nearer origin caudal than end muzzle. Rays, D. 1.8. A. 1.8. V. 7 and 8. P. 13.

Length 2.875 inches, depth caudal peduncle at middle .19 in. Teeth in numerous specimens 1.4—4.1.

Color olivaceous, with a plumbeous band along the posterior half the lateral line; thoracic region and lower half the sides of head silvery, remainder of head blackish. Median part of caudal fin, a spot on the upper hinder portion of the dorsal, and a narrow vertebral line, black.

Many specimens of this species are in Museum Academy, from the St. Josephs River, in Southwestern Michigan.

This species bears a superficial resemblance to the *Hybopsis plumbeolus*, but apart from the difference of dentition, and the spot on the dorsal fin, this species has a smaller eye, longer ventrals, etc.

Mouth (typically) very small inferior, without barbels; pharyngeal teeth always hooked, and furnished with masticatory surface, latter sometimes on two teeth only, 0.4—4.0, 1.4—4.0, or 1.4—4.1, 2.4—4.1, and 2.4—4.2. Scales large or moderate, a large surface exposed; anal fin short. Length of alimentary canal a little less than length of head and body.

As deviating from the ordinary form, *H. hæmaturus* has the mouth terminal, and *H. heterodon* the mandible longer, and mouth slightly oblique backwards; it is indeed questionable on this account whether the latter belongs to the genus. The dentition, so far as known, is as follows: Teeth 4—4, *H. hæmaturus*, *stramineus*, *dorsalis*, *regius*, *procne*, *volucellus*; sometimes with one inner on one side, *heterodon*; 1.4—4.0 *storerianus*; 2.4—4.1 *hudsonius*, 2.4—4.2 *H. chalybaeus*, *plumbeolus*; of the above the masticatory surface is most extensive, and the hook shortest in *H. hæmaturus* and *H. tuditanus*, which thus approximate *Hybognathus*. In the species of that group the head is more massive; in the *procne* type the head is narrower, and the body more compressed, while in sects. A, B, and C in part, the orbit is longitudinally oval.

The genus, indeed, bears much resemblance to *Hybognathus*, and several of its species have been described under the latter head by Girard and myself. Most of them are of small size, and all of weak organization. They are ornamented rather with lustre, than hue, for I am not acquainted with any which display the bright colors of the *Clinostomi* and *Argyrei*. They occur throughout those regions of the United States east of the Rocky Mountains which have been as yet examined.

The natatory bladder occupies the whole length of the abdominal cavity in the species examined. Food, insects and crustaceans.

Allied to this genus by the structure of its dorsal fin, alimentary canal, and teeth, is *Cochlognathus*, Baird and Girard. It differs in the peculiar character pointed out by Girard, the entire cutting edges of the jaws. The appearance of the known species is much that of *Hyborhynchus*.

I. Head 5.5 to 6 times in length (including caudal fin).

Pectoral fins not reaching ventrals.

A. Teeth +4—4+; mouth small inferior; lateral line complete; a broad lateral silver band.

Scales 6—38—34; teeth 2.4—4.1; eye three times in head; head five and two-thirds in total; muzzle descending in profile, sometimes very obtusely. A. 8: squamosal region prominent. HUDSONIUS.

Teeth 1.4—4.1; head one-sixth the length; eye one-fifth head; A. 9.

STORERIANUS.

II. Head 4.5 to 5 times in total length.

B. Teeth 4—4; mouth inferior or horizontal, small; lateral line complete.

a. Pectoral fins not reaching ventrals.

Scales 7—43—4, not dark edged, 27 in front of dorsal, which is markedly nearer caudal than end of muzzle; muzzle very obtuse, mouth very small inferior; sides silvery, often with a dark band; no dorsal band, a dark

spot on middle of front dorsal rays, and faint one at base of caudal ; parietal region broad, flat, temporal angled ; eye 3.5 in length head, which enters 4.5 times to base caudal. TUDITANUS.*

Scales 5—36—4, 15 rows anterior to dorsal fin, which is equidistant between base of caudal and end of muzzle ; muzzle very obtuse, mouth moderate ; sides silvery ; often a median dorsal band, no spot on dorsal fin ; parietal and temporal region rounded ; eye larger, three times in head, which is four times to base caudal. STRAMINEUS.

“Mouth protractile downward ; snout pointed ; a deep black band from nape to base of dorsal, round both sides of it to median line again ; olive, sides silvery, a deep rose-colored spot at base of dorsal fin.” (Agassiz.)

DORSALIS.

Scales 5—31—3—3, 13 rows in front of dorsal, a dorsal line and burnished plumbeous lateral band, with blackish pigment below ; teeth 4—4 ; eye one-third longer than deep ; head one-fifth total, front decurved, obtuse, mouth horizontal, mandible shorter ; caudal peduncle slender, its median depth one-fourth length from first anal ray, A. 7.

PROCNE.

aa. Pectoral fins attaining ventrals.

Head flattened, elongate ; eye contained three and one-third times ; head to base caudal three and three fourths ; scales 4—34—3 ; dorsal length half from its first ray to base caudal ; caudal peduncle slender ; no dorsal band ; a darkish lateral.

VOLUCELLUS.

“Head broad, nearly one-fourth length ; snout short, broad ; eye one-third head, line of margin reached by maxillaries ; caudal peduncle slender.” (Agassiz.)

GRACILIS.

C. Teeth 4—4 ; mouth obliquely descending ; lateral line complete.

Scales 7—44—4, blackish-edged above lateral line, 21 rows in front of dorsal, which is nearer caudal than end

* *Hybopsis tuditanus*, n. sp. nov.

This is an abundant species, and has so much the aspect of *Hyborhynchus notatus*, as to be readily mistaken for it ; its resemblance consists in the broad flat head, and angulated temporal region, size of scales, rounded muzzle, and even in dentition, but the latter differs *toto cœlo* in the structure of the alimentary canal and dorsal fin, form of the scales and the tubercles, and great thickening and obtuseness of the muzzle.

Cranium flat above, temporal width 1.5 in length above, and equal length from end muzzle to posterior margin of orbits. Dorsal fin lower than usual, height anteriorly equal its basis, six-sevenths of to equal height of anal, and three-fourths length of caudal ; basis of anal three-fifths basis dorsal. Greatest depth 5.33 times to origin of caudal. Muzzle rounded, very obtuse in profile, broad as two-thirds parietal width. Mandible short, outline slightly angulated in front.

Total length 3.1 in. ; from end muzzle to first dorsal ray 1.375.

Olivaceous above, dorsal scales narrowly black-edged ; no vertebral band ; sides and below silvery. The types of this species were procured in the Detroit River ; these with numerous others, from the St. Josephs, exhibit a dark lateral band extending from the end of the muzzle to the base of the caudal fin, especially dark on the operculum. Specimens from the Wabash at Lafayette, Indiana, where I have taken it in large numbers with the *Hybognathus nuchalis*, Agassiz, do not exhibit this lateral line. In all is a basal caudal spot, and dark spot at middle of anterior dorsal rays, the latter very indistinct in young specimens.



of muzzle; muzzle little obtuse, mouth moderate, terminal, maxilla to orbit; no lateral silver band or dorsal spot; a caudal basal spot; tail red; temporal region rounded. A. 1.7. HÆMATURUS.*

"Scales 6—38—4; head one-sixth total length; teeth 4—4;" mouth oblique, large; A. 11.9. REGIUS.

Form compressed; vertex convex; scales 6—35—3; eye 3.5 in length head, which enters four times to origin of caudal; ventral fins to vent; a lead-colored lateral and dorsal band. A. 1.8. FRETENSIS.†

D. Teeth +4—4+; mouth obliquely descending; lateral line complete.

Form compressed; vertex convex; scales 6—39—3; eye 2.75 in length of head, which is over four times in length to base of caudal; depth 4.66 in same; ventral fins not reaching vent; no lateral or dorsal bands. A. 1.9. Teeth 2.4—4.2. PLUMBEOLUS.

Scales 6—35—6—3, 17—19 rows in front of dorsal; muzzle nearly flat, mouth oblique, to opposite orbit; eye one-third head; lateral line decurved complete, caudal peduncle slender; teeth 2.4—4.2; A. 1.8. Brown, a burnished broad black band from tail to muzzle, light-bordered above on the latter. CHALYBAEUS.

E. Teeth 4—4; mouth obliquely descending; lateral line imperfect.

Scales 5—36—3, 13—14 vertebral in front of dorsal; a blackish rostral and lateral band; eye three times in head; head about equal depth, four and three-fifths in total length; maxilla to opposite orbit; muzzle acuminate, flat, mouth oblique, lip opposite upper rim of pupil; mandible a little longer; back compressed elevated; caudal peduncle stout; lateral line posteriorly imperfect; anal 8. HETERODON.

Scales 5—36—3, 12—13 rows crossing anterior to dorsal fin; muzzle very obtuse, shorter than orbit; mouth oblique, top of arch opposite lower rim of pupil; eye one-third head which is equal depth and four and one-fifth times to base of caudal; teeth 4—4. A. 7. Anterior fifth of lateral line existing; straw-colored, with a black band on sides and round muzzle, orange-bordered above on latter region. BIFRENATUS.

* *Hybopsis hæmaturus*, n. sp. nov.

Eye three and one-half times in head, which measures four times to origin of caudal. Temporal width one and three-quarter times from nape to end muzzle. Greatest depth four and four-fifths in length to base caudal. Lateral line very slightly deflexed, rising opposite hinder rays of dorsal. Basis of dorsal three-fifths height anteriorly, near four-fifths front of anal. Anal basis short, rays 1.7.

Above blackish lead-color; head above, and behind, and before orbit, blackish; a faint blackish band on middle of sides from last dorsal rays to caudal, a basal dorsal spot, continued as a line on the fin; head below and median line of body whitish. Total length 2.75 in.

This plain species is abundant in the St. Josephs River, Michigan, and at Michigan City, Indiana. Its dull red tail is a noticeable feature of coloration.

† *Hybopsis fretensis*, Cope, sp. nov.

General appearance, that of *Alburnellus*. Lateral line decurved, its course on the caudal peduncle below the middle line. Seventeen rows of scales in front of the dorsal fin; scales of body with concentric stronger than radiating lines. Mouth quite oblique, middle premaxillary line opposite middle of pupil; maxillary not attaining line of orbit. Length muzzle equal diameter orbit. Pharyngeal teeth more or less crenate; external angle of the pharyngeal bone scarcely projecting.

Total length 2 in. 4.5 lines; end of muzzle to basis ventrals 10.85 lines; to basis anal 1 in. 4.5 lines.

Reddish-olive above, with a dark median dorsal band; lateral leaden silvery band, not distinctly defined; opercular apparatus and pre- and sub-orbital regions brilliant silver; below less brilliant; a dark spot at base of caudal.

A single specimen of this species is in the Museum Academy, from near Detroit, Michigan.

Of the above species which do not enter our limits :

Hybopsis stramineus is *Hybognathus stramineus* in Proc. Acad. Nat. Sci., Phila., 1864, 283. In the description of this species, l. c., the position of the dorsal fin is erroneously described, and is as now corrected. A number of specimens also from Detroit River, exhibit a vertebral band from nape to caudal fin.

H. heterodon, *Alburnops heterodon*, Cope, l. c., 281. The variation in the structure of the teeth which I have mentioned under the original description, may be thus accounted for: the crenate teeth are immature, as occurs in other genera; those without masticatory surface are rare, perhaps also immature.

H. regius, *Hybognathus regius*, Girard. This species has strongly-hooked teeth, as exhibited in preparation in Museum Surgeon-General, Washington, D. C., and the mouth is scarcely inferior, hence neither a *Hybognathus* nor typical *Hybopsis*.

H. volucellus, *Hybognathus volucellus*, Cope, l. c.

Alburnus nitidus, Kirtland, Cleveland Annals Science, probably belongs also to *Hybopsis*.

HYBOPSIS CHALYBAEUS, Cope.

Head 3.8 (sometimes 4) times in length to base of caudal; length of latter equal from opercular margin to nares. Muzzle shorter than diameter of orbit, slightly acuminate, and exceeded by the tip of the mandible when viewed from above; head flat above, less angulate on the temporal region than many species, the superior plane narrower there than between the orbits; supraopercular region oblique. Teeth slightly hooked, masticatory surface well marked, upper tooth nearly opposite angle of the ala. Dorsal fin elevated, with eight rays a very little behind above ventrals; latter pointed, reaching anal. Anal slightly elongate, exceptionally with nine rays; pectorals pointed, not reaching ventrals. Superior outline rising to dorsal fin, then immediately descending, forming with the nearly parallel ventral line, the elongate caudal peduncle. Caudal fin deeply forked.

The broad burnished black lateral band does not descend below the lateral line on the middle of the body; it occupies one and two half rows of scales. Above it on head and body the color is fulvous brown, excepting a straw-colored crescent from orbit to orbit round the nose; terminal half of mandible black; sides of head below, silvery, of body straw-colored; no distinct vertebral stripe, or spots on the fins.

This is a very small species, nearly the smallest of the Cyprinidæ; a specimen before me, apparently fully grown, measures only 1 inch 8.5 lines in total.

Several specimens of this species were taken in a tributary of the Schuylkill River, near Conshohocken, by Charles H. Darlington, and the museum of the Academy possesses numerous others.

This species is most allied to the *H. heterodon*, and in less degree to the *H. procne*; very careful examinations of large numbers of specimens of the three convince me of the value of the characters adduced.

I have satisfied myself that the *H. chalybaeus* cannot be the fry of any species known

to me. The scale formula and form of head in the *H. hudsonius* are quite different; the appearance as well as details of the living fry of *Hypsilepis cornutus* and *kentukiensis* from the same waters, is entirely distinct. In general the characters are most like those of the last named; leaving out of view the generic difference in the form of the scales, specimens of nearly the same size may be distinguished as follows:

H. kentukiensis.

Dorsal outline continuous beyond dorsal fin;
caudal peduncle deep.
Eye three and two-thirds times in head.

H. chalybaeus.

Dorsal outline depressed beyond dorsal fin,
forming slender caudal peduncle.
Eye three times in head.

The coloration of the young *kentukiensis* is identical with that of the adult, and entirely different from that of the present species.

The *Hybopsis chalybaeus* is much less abundant than the *H. procne*; I have not yet seen it sold for aquaria, in which it would, however, be a greater ornament. The stomach of a specimen opened, contained minute insect larvæ.

HYBOPSIS BIFRENATUS, *Cope.*

This small species agrees in dentition, squamation, and radial formulæ with the *H. procne*, but differs in the deeper body, more oblique mouth, the almost absence of the lateral line, and in coloration. Its affinities are really nearer the *H. heterodon*, from which the points of the table will distinguish it; while its general appearance is surprisingly like the *H. chalybaeus*.

Color above straw, the scales delicately brown-edged; below impure white, with a narrow black line along base of anal fin to caudal. Along each side from the caudal fin round the end of the muzzle, including the end of the mandible, a shining black band, one and one-half scales in width. This is bordered above on the muzzle, forming an arc from orbit to orbit by an orange band, which is strongly margined above by the brown of the top of the front. Opercular and suborbital regions below the black band, pure silvery.

Front convex between the orbits; length of muzzle equal diameter of iris band and pupil, sometimes nearly equal orbit. Iris colored in continuation of the lateral band. The lateral line rarely extends half way to the dorsal fin, while the pores of the same may be observed at the bases of the scales for half the remaining length of the animal. Length of the largest specimen, nineteen lines; breadth of muzzle at nares 1.5 lines. Radii of the scales strong.

I have examined carefully at least one hundred individuals of this species which I took near the mouth of a stream which flows into the Schuylkill at Conshohocken, in company with *Hybopsis procne* and *Hypsilepis kentukiensis*. Large numbers of the three were taken, from young of six lines in length to nearly adult age of the last mentioned. The

young of the *H. bifrenatus* and *H. procne* are readily separated, since the latter species exhibits its form and its lateral line in specimens of seventeen lines long and upwards, as well as its color. The *H. procne* is more silvery, and exhibits from the smallest size upwards a silver lateral band with black specks at the bases of the scales.

The dentition of these species, like that of the *Hypsilepis kentukiensis*, does not vary from the formula at any age. The lateral line is, however, wanting in both *Hypsilepes*, smaller than nine lines, and *H. procne* below seventeen lines. I am inclined to anticipate that the *H. bifrenatus* will be found to attain a rather larger size, though most likely one of the smaller Cyprinidæ. My specimens were taken in the beginning of winter.

HYBOPSIS PROCNE, Cope.

Hybognathus procne, Cope, Proc. A. N. S., Phila., 1864, 279.

This small species may be readily distinguished among others common in our streams by its long caudal peduncle and tail, its large brown-edged dorsal scales, and plumbeous lateral band.

The dorsal region is compressed and slightly elevated at the dorsal fin, and the muzzle strongly obtuse; the eye is large and longitudinally oval. Below white tinged with yellow. The bases of the dorsal and anal are five-eighths to one-half the length of the first rays of those fins, and the bony ray of the former is two-thirds the same height. Caudal deeply furcate, and with acute lobes. Rays D. 1, 8 A. 1, 7, constantly one less than in *H. chaulybaeus* and *hudsonius*, the last being deeply fissured in the three; V. 1, 8, reaching vent; P. 12-13. Fins unspotted; a blackish line along origin of anal, and continuation of lateral band on base of caudal.

This species rarely attains 2.5 inches; a common length is 2.187, of which caudal fin is .437; from middle origin latter to first anal ray .562; end muzzle to origin dorsal .875; this distance is sometimes less than, sometimes equal to, from latter point to origin caudal.

This fish prefers comparatively sluggish waters, and abounds in the streams of the low lands which empty into the ocean and its estuaries. In our hill country it occurs in mill-dams and coves of the larger streams, in fact, in situations not chosen by *Argyreus atro-nasus*. I have seen it from the Delaware, Schuylkill, White Clay Creek, of the Delaware basin, and Conestoga of the Susquehanna, where Jacob Stauffer originally observed it, but not farther westward.

I had thought this fish the fry of some larger species, but am now convinced of its small adult age, as being one of the smallest known Cyprinidæ. Besides having seen a great number of specimens, I have found females much distended with eggs, an observation also made by my friend, Jesse Burk. I have watched them also going through the movements of preparing a place of deposit for eggs.

Hybopsis procne is very commonly sold for aquaria in Philadelphia. I have seen it captured as food by the wampum snake (*Tropidonotus sipedon*).

HYBOPSIS HUDSONIUS, *Clinton*.

Amer. Lyc. M. H., New York, 1824, 49, Pl. II, f. 2, Agassiz, Putnam Bulletin, Mus., Comp. Zool., Cambridge. *Hudsonius fluviatilis*, Girard, Proc. A. N. S., Phila., 1856, 210. *Hybopsis phaënna*, Cope, l. c., 1864, 279.



I have this species from the Delaware near Trenton. It no doubt inhabits the Susquehanna, as I have procured it from the Potomac near Washington. It is in general northern in its distribution, occurring commonly in the waters of the great Lakes. Specimens from our regions have a less obtuse and rounded muzzle than some from Lake Huron and than Clinton's figure, but I incline to ascribe the more conic form to maturer age, as it accompanies increased size. There are also slight variations in the form of the operculum, some having an individual feature in the greater prolongation of its anterior inferior angle. A specimen from the Potomac exhibits the anomaly of the successional outer (or long) series of teeth having taken its place in advance of the shedding of the previous set, hence they are 2. 4. 4—4. 4. 1. Those of the outer row are without masticatory surface, those of the median as in the other species of the genus, the conic ones much truncated. Occasionally the grinding surface is found but slightly developed.

In this species the upper surface of the cranium is broad; the temporal region rounded; distance between nares about equal from anterior margin of same to end of muzzle. Eye a little less than one-third length of head; latter five and one-third times to concavity of tail, and more than equal greatest depth of body; in *storerianus* the head does not equal the depth, and the back is more compressed. Angle of mouth not posterior to anterior nostril. Scales 5—38—4. Lateral line very slightly deflected opposite dorsal fin. Base of caudal to posterior edge of dorsal equal from latter to beginning of skin of head. Rays D. 1.8; C. 19; A. 1.8, its outer border concave like that of dorsal; V. 19; P. 15. Lateral band and below silvery, a dark shade passing through former; no spot at base of tail. Above pale ochre, with a faint median line. Total length 4.75 inches; caudal fin one inch, its peduncle to base of anal 1.125 inches, depth half way between anal and caudal .344. End muzzle to base dorsal 1.875; same to base ventral; length pectoral .72, of dorsal .875.

A specimen from the Conestoga, half grown, exhibits some peculiarities, as a less obtuse muzzle than larger specimens from Michigan, and a lateral lead-colored band two and a half scales in width anteriorly.

Yellow olive above with dorsal line and brown-edged scales, below yellowish-white. No distinct spot at base of dorsal. Cranium and back broad.

Height of dorsal one and one-half its base, first ray (osseous) half the height, nearer end muzzle than origin caudal; base of anal more than two-thirds height of first rays.

Total length 2.875; caudal fin .5; middle origin caudal to first anal ray .78; end muzzle to origin dorsal fin 1.187.

In this specimen the differences between *H. hudsonius* and the *H. procne*, which I had once suspected to be the young, are marked. First, the invariably greater number of scales above and below the lateral line; second, the constantly normal number of anal rays; the deeper caudal peduncle, which is one-third its length from first anal ray; the broader lateral band, which is in the *procne* but 1.5 rows scales in width. Pharyngeal teeth I could only find 1.4—4.0. There may still be some question as to the pertinence of this specimen to *H. hudsonius*.

ALBURNELLUS, *Girard*.

Proceedings Acad. Nat. Sci. Phila., 1856, 193.

This genus represents and nearly resembles the *Alburnus* of the Old World; whether the latter genus occurs on the North American Continent or not is as yet unknown.

The dentition is represented by the formula 2.4—4.2; the teeth are without masticatory surface proper, except perhaps in *A. rubrifrons*. There is a narrow, scarcely worn plane in both *A. jaculus* and *A. arge*, on one or two of the teeth.

In the three species here compared the extremity of the maxillary bone reaches the vertical line of anterior margin of the orbit, and the distance from the base of first dorsal ray to caudal equals from former to posterior margin or middle of orbit.

Diameter of eye less than to muzzle, four times in length of head; head five times in total. Scales 6—39—3. A dark vertebral line, a dark lateral band, sides and belly silver.

RUBRIFRONS.

Diameter of orbit less than to muzzle, 3.5 to 3.7 in length of head; latter five times in total, four and one-fourth to base of caudal. Scales 6—39—2, lateral line most decurved. No dorsal or lateral band, sides and belly silvery.

JACULUS.*

* *Alburnellus jaculus*, m.

A very elongate, light olivaceous species, which occurs in shoals in the clear water of the St. Josephs River, and its tributary the Dawagiac. These streams debouch into the head of Lake Michigan from the east.

Muzzle from orbit longer than diameter of latter; end of maxillare opposite anterior margin orbit, mandible acuminate without symphyseal knob. Frontal breadth two-thirds temporal, equal orbit's diameter. Greatest depth seven and a half times in length (including caudal), equal from end muzzle to preopercular border. First dorsal ray equidistant between origin of caudal and posterior rim or middle of orbit, as far behind opposite ventrals as the posterior ray is in advance of anals. Base of dorsal equal two-thirds its height; base of anal equal

Diameter of orbit greater than length of muzzle, three times in length of head ; head five and one-half times in total four and one-half to base tail. Scales 5—39—3. A dark vertebral line, and defined lateral silver band.

ARGE.*

Other species described as inhabiting the United States, are ;

A. rubellus, Agass., Lake Superior ; *A. lineolatus*, Ag., Osage River ; *A. zonatus*, Ag., Putnam's Bulletin Mus., Comp. Zool., I, 9, Osage River ; *A. formosus*, Putnam, l. c., Mobile ; *A. dilectus* and *umbratilis*, Girard, Pr. A. N. S. Phila. 1856, 193, Arkansas R. ; *A. amabilis*, Girard, R. Leon, Texas ; *A. megalops*, Girard, San Felipe, Texas ; *A. socius*, Girard, Live Oak Cr., Texas. The only species known to occur in Pennsylvania is

ALBURNELLUS RUBRIFRONS, *Cope*.

Proc. Acad. Nat. Sci., Phila., 1865, 85.



The head is elongate conic and compressed, the outline of the vertex and front nearly plane, scarcely descending at the end of the muzzle ; length one-fifth the total (thus differing from *dilectus*, Gir., one-sixth). Operculum a little higher than long. Mouth elongate, very oblique, end of maxillary opposite anterior margin of orbit ; border of premaxillary above opposite middle of pupil (differing in this from *rubellus*, Ag.). Orbit nearer end of muzzle than to opercular border, its diameter not reaching former, and contained four times in length of head. Shape regularly fusiform, greatest depth five and one-half times in length including caudal.

Scales 6—39 + 2—3 fewer than in *umbratilis*, more than in *oligaspis*, and much as in *amabilis*, *megalops*, and *socius*. These species are not so elongate, have differently proportioned heads and different coloration. The lateral line has a long slight deflection as far as the dorsal fin. The pectorals do not reach the ventrals, which

three-fourths longest dorsal and anal rays. Pectorals extend three-fifths way to ventrals, the latter do not reach vent. Depth caudal peduncle one-third from middle base of caudal fin to opposite last anal ray. Rays D. 1. 8. A. I. 10 or 11. V. 8, P. 13.

Upper surfaces half way to lateral line olivaceous, the scales darker bordered ; from this point below, leaden silvery ; top of head, muzzle, caudal, dorsal, and pectoral fins dusky.

Length 2.75 inches.

Habitat. Southwestern Michigan ; numerous specimens Museum Academy.

* *Alburnellus arge*, m. sp. nov.

Also an elongate species, less than the preceding, with deeper head and larger eye.

Muzzle from orbit less than diameter of latter ; end of os maxillare opposite anterior rim of same ; mandible acuminate, not projecting when closed, no symphyseal knob. Frontal breadth two-thirds temporal, and three-fourths orbit. Greatest depth a little over seven times in total length equal from end muzzle to preopercular border. Proportions and formula of fins as in the last. Lateral line straight. A silver band along anteriorly above the latter, dark-edged above and below. Muzzle and lips blackish.

Length 2.75 inches.

Habitat. Either the Detroit River or the St. Josephs, the locality confused. Numerous specimens.

originate anterior to the dorsal, and do not extend to the anal. Base of anal more elongate than in *rubellus*, equal depth of body at its fourth ray. D. I. 8. C. +19+. A. 2, 10. V. 8, P. 11, the four upper rays enlarged in the spring, as in *Argyreus*, etc. Scales of upper surfaces covered with minute rugosities during the same season. From origin of caudal to that of dorsal equal from latter to posterior border or middle of orbit. Length 2 in. 6 lin.

Above yellowish-olive, the scales with punctulate margins; a median dorsal line. A dark lateral band has a distinct outline on the third row of scales above the lateral line, but vanishes in punctulations below; it is broader and more distinct on the caudal peduncle. From its superior border a silver reflection extends over the white abdomen. Sides of head silvery; chin, muzzle, lips, front, and vertex light vermilion during the breeding season. The bases of the fins, except the caudal, are similarly colored at this season. The pharyngeal teeth are but little hooked; in three specimens, 2.4—4.1, and in two, 2.4—4.2.

As may be supposed, this is an elegant little creature. It is found in considerable abundance in the Kiskiminitas River, and no doubt in other tributaries of the Alleghany, though I have only seen it from the former stream. Of its habits nothing is known.

STILBE, *Dekay*.

Nat. Hist. New York, 1842, Gill, Canadian Naturalist, 1865. *Plargyrus*, Rafinesque. Ichthyologia Ohiensis, Putnam Bulletin Mus. Comp. Zoology, No. I. *Luxilus*, Raf., Girard, Proc. A. N. S. Phila., 1856.

This form is readily distinguished externally by the elevation and compression of the body and length of anal fin; the head is small, and the mouth oblique and superior or terminal. The ventral fins originate further in advance of the line of the dorsal than usual; the isthmus is moderate.

STILBE AMERICANA, *Linnæus*.

Cyprinus americanus, Syst. Nat., 1766. *Cyprinus chrysoleucus*, Mitchell, 1815. *Abramis versicolor*, Dekay. *Leucosomus americanus*, Girard,* 1853.

Scales rather large, (9—)11—46—4, radii 4—6, much stronger than the numerous, close concentric lines. Lateral line much decurved, not occupying even the middle of the caudal peduncle. Head slightly concave between the orbits, contained five and one-fifth times in length to end tail, occipital region very convex above preoperculum. Eye round, three and two-thirds in length of head, once in muzzle; end of os maxillare in line with nares. Preorbital bone a trapezium higher than long. From origin of dorsal to median base of caudal equal from former to opposite posterior margin of orbit; its base one and



* Putnam Bulletin Mus. Comp. Zool., l. c., includes *Leuciscus boscii* as synonymous with the present species, but erroneously, as it is probably a *Lavinia*. Vid. Pr. A. N. Sci. Phila., 1864, 283.

three-fourths height of first ray, and two-thirds base of anal, its superior outline straight; first (soft) anal ray just equal base of anal; exterior outline of latter concave. Pectorals extend two-thirds the distance to ventrals, and latter to vent. Rays D. 1. $7\frac{1}{2}$, A. 2, 14. V. 9, P. 16. Twenty rows of scales between isthmus and ventral fins.

The upper surface of the head in back are in this species usually blackish, and the rest of the body with greenish, brassy, or golden lustre, the latter always on specimens from sluggish and muddy streams.

This *Stilbe* rarely exceeds seven inches in length. In a specimen five and five-sixteenths inches long, the caudal fin measures one inch, caudal peduncle to last anal ray .75; depth at latter point nine-sixteenths; depth at first dorsal ray one and three-eighths; at middle of pectoral 1.25; at occiput .875; length base of anal thirteen-sixteenths inch.

This species is called minnow or shiner, and inhabits all the waters of our State. In our rapid rivulets it is rarely seen of large size, and chiefly seeks the "cut offs" and ditches which produce *Anacharis* and *Nuphar* (*Splatterdocks*). It is properly a fish of the dams and ditches, and the sluggish streams near the coast, where it is extremely abundant. In the ditches near Philadelphia a mischievous mode of taking it, practised by boys, is to feed them with dough mixed with ground *Cocculus Indicus*.

It is abundant throughout New England and the West, and has been brought from Lake Whittlesey, Minnesota, by Dr. J. H. Slack, of this city. I have not been able to distinguish a *S. compressa* among our numerous specimens from Indiana, Michigan, etc.

CHROSOMUS, *Rafinesque*.

Ichthyologia Ohiensis, 47, Agassiz, l. c., 225.

Pharyngeal teeth with extensive masticatory surface, 4-5 or 5-5, no outer row; scales very small, largely exposed, lateral line very short or none. Basis of anal fin short, dorsal above the space between ventrals and anal. Mouth small terminal; isthmus narrow.

Prof. Agassiz, who characterized this genus first, affirms the teeth of the *C. erythrogaster* to be arranged 5-5; in nine specimens, however, I find but two with this arrangement, and seven 4-5; the number is 5-5 in the *C. eos*. In his paper on fishes from the Tennessee River, Prof. A. identifies a species with the former, which he says has continuous lateral line; this is perhaps a species of another genus.

Two species only are known, and both occur in Pennsylvania.

Mouth reaching opposite orbit; teeth 4-5.

Scales longitudinal rows 34-5; two dark bands separate on caudal peduncle; back unicolor; usually a lateral line.

ERYTHROGASTER.

Mouth not reaching line of orbit; teeth 5-5.

Scales longitudinal rows 23; dark lines united on caudal peduncle; back spotted; no lateral line.

EOS.

CHROSOMUS ERYTHROGASTER, *Raf.*

L. c., Agassiz, l. c., Cope, Proc. A. N. S. Phila., 1864, 281.

Outline from muzzle to dorsal fin gently arched and compressed, then rather suddenly descending to the elongate caudal peduncle; ventral outline nearly straight. Head slightly elongate, contained in length to base of caudal four and one-fifth times; operculum longer than high, rounded right-angled posteriorly; muzzle not quite equal an eye's diameter; latter 3.25 to .50 in length of head.



Scales small 34—5 to 80—85, concentric lines strongest, their edges on the belly so thin as to transmit the form of the base of the scale below, giving the appearance of a reversed imbrication. Lateral line extending on about 32 scales. Base of dorsal fin two-thirds its height; latter two and two-thirds times in length from first ray to base caudal; base of anal slightly longer than that of dorsal, equal depth of caudal peduncle at middle. Rays D. 1. 8, C. 19, A. 1. 9—8. P. 13, the rays on ♂ thickened, form rounded, not attaining ventrals; latter just reaching vent.

Total length 2.375 in.; end muzzle to first dorsal ray 1.06 in.; latter to origin caudal .975 in.; greatest depth at ventrals .445 in.

Above bright chestnut with a blackish vertebral line, margined below by a blackish band from the superior opercular angle straight to the upper side of the caudal peduncle; a broader black band from end of muzzle to middle caudal peduncle, decurved on side, and separated by a broad silver band from the superior; below this silvery. Both the belly and the band are in spring and summer brilliant crimson.

Specimens of this species from Illinois exhibit a more obtuse, rounded muzzle; one from the White River, Indiana, exhibits a straight muzzle, while several from Macomb County, Michigan, from waters flowing into Lake St. Clair, have a shorter muzzle, not at all decurved. The latter have also not a trace of lateral line, which is present in all the rest.

In Pennsylvania this species occurs in the Mahoning and other tributaries of the Alleghany. It is not exceeded by any of the family in brilliancy of color or gracefulness of form, and is often seen in aquaria.

CHROSOMUS EOS, *Cope.*

Proc. Acad. Nat. Sci. Phila., 1861, 523.

Another small and pretty species, representing the last in the water basin of the Susquehanna. The number of teeth 5—5, is unusual among our species.

Mouth small, not extending so far as opposite nares, chin slightly projecting; eye a little over three times in length of head, one-fifth less than interorbital width. Temporal width equal from occiput to opposite anterior margin pupil. Greatest depth five and one-third times from end muzzle to origin of caudal fin, head four times

in same. Inferior border operculum straight, one-fourth longer than posterior. Longitudinal rows of scales 23, transverse 75—8, concentric ridges stronger. Fins all quite short, rays D. 1. 8. C. 18. A. 1. 8, V. 8, P. 16. Dorsal outline nearly straight, front very gradually descending.

Specimens taken in the beginning of autumn were yellowish silvery below, as far as a dark band in the usual position of the lateral line; the latter commences at end of muzzle, and is much decurved on thoracic region. A narrower dark line on the upper lateral region confluent with the lower on caudal peduncle. Above lower band brownish interline with small brown spots.

Total length 2.312 in.; end muzzle to origin dorsal one in.; latter to origin caudal .81.

I have seen four specimens of this species from the Meshopen Creek, Susquehanna County, Pa., a tributary of the River Susquehanna.

HYBORHYNCHUS, *Agassiz*.

Am. Journ. Sci. Arts, 1855, 222.

The separation of the first bony dorsal ray is the most prominent feature in this genus, as I have pointed out, Proc. Acad., 1864, 283. The pharyngeal teeth are arranged 4—4, and often a little hooked; they much resemble those of some species of *Hybopsis*. The parietal region is flat, and the temporal abruptly angulated, as mentioned by Agassiz, but this occurs in almost as great a degree in some *Hybopses*. The genus most nearly allied is *Pimephales*; it agrees with it in the development of the frontal tubercles of the male taking place across the muzzle only, and in the increased length of the alimentary canal. In *H. notatus* the intestine presents five flexures; in *P. promelas* there are seven, and the length is two and two-thirds that of the head and body.

The figures given by Girard of the species he has described under this genus, do not present the peculiarity of the dorsal fin, and are either erroneous or the species do not belong to the genus.

HYBORHYNCHUS NOTATUS, *Rafinesque*.

Agassiz, l. c. *Minnilus notatus*. Raf., Ichth. Ohiensis, 47.

In Pennsylvania this species occurs only, so far as my observations have extended, in tributaries of the Ohio. I have seen it from Michigan, while Prof. Agassiz records a range of nearly all the tributaries of the Mississippi and Lakes, with Lake Champlain, and the Mohawk.

Pharyngeal teeth slightly hooked. Frontal region flat, its breadth more than half length of top of head; outline of the latter broadly truncate. Profile truncate. Eye contained four times in length of head, once between its anterior border and the end of the muzzle, a little more than half frontal width. Length of head entering four and one-half times in length to base of caudal fin, and equal greatest depth of body.

Scales 6—44·5—4, exposed portions higher than long. Dorsal fin longer than high, highest anteriorly, superior outline straight, 1. 8; caudal not deeply forked, 19; anal free border longer than anterior, 1. 7; ventrals not reaching vent, 1—8. Total length three inches. Length from base of caudal to anterior base of dorsal greater than from latter point to end of muzzle.

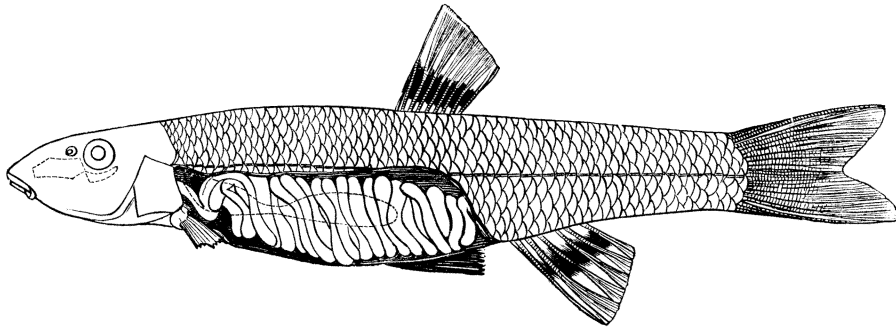
General color reddish, cheeks silvery. A darker shade along lateral line, and a black spot at the base of the tail.

In general features this species is allied to the *Pimephales*, the excessively broad obtuse muzzle, with tubercles in front, and small inferior mouth, giving it much the same physiognomy. The arrangement of the former is as follows:

There are two rows crossing the front of the muzzle; the inferior of six, of two on each side on the premaxillary border, and an outer near the eye; the superior of five, one on the middle line. A third row of four is on the border of the superior plane, one behind each pair of nares, and one on each side the middle line of the muzzle.

CAMPOSTOMA, *Agassiz*.

Amer. Journ. Sci. Arts, 1855. Girard, Proc. A. N. S. Phila., 1856, 170.



Species of this genus have as yet been only found in the tributaries of the Ohio, in our State. The known species are from the waters flowing into the Lakes, the Mississippi, and the Gulf. While it represents in our waters the *Chondrostoma* of Europe, as pointed out by Agassiz, the arrangement of the abdominal organs is now found to be so peculiar as to separate it more widely from the latter than has been hitherto accepted. This has been indicated above in the diagnosis of the tribe *Mesocysti*. *Hybognathus* indeed coincides more nearly with *Chondrostoma*, though it lacks the acute labial sheaths, but the palæotropical genus *Gymnostomus*, Heckel, affords an intermediate form of mouth. In

the palæarctic genus the alimentary canal attains 2.5 the length, in *Hybognathus* 4 times, while in *Gymnostomus* the length exceeds that of *Campostoma*, amounting to from 8 to 11 times the length (Heckel). But in these genera it is arranged as in *Chrosomus* and *Stilbe*, in a series of horizontal convolutions in no wise affecting the position of the natatory bladder. Indeed, in no other genus than *Campostoma* have I observed the latter organ involved in vertical coils of the intestines, and separated from contact with the abdominal walls. In *C. dubium*, sixteen coils may be counted from the side, each corresponding to an intercostal space; the intestine is eight and three-fifths length of head and body. In *C. hippops* it is a little shorter. The natatory bladder in both is much diminished in size, not extending behind the anterior two-thirds of the abdominal cavity. This is appropriate to the abode of the species, near the bottom, where they obtain their favorite vegetable food. In the more numerous species of carnivorous habit, that rise to seize insects on the surface, the bladder extends throughout the length of the abdomen.

A distinct though less degree of shortening is seen in the genera *Gymnostomus* and *Hybognathus*. *Hybognathus nuchalis*, Agassiz, the only known species of the genus, I have found to be abundant in the Wabash River, and Dr. William A. Hammond presented specimens to the Museum Academy Natural Sciences, from the Platte River, near Fort Riley, Kansas. Its digestive canal is longitudinally folded, exhibiting six flexures. The peritonæum is black.

The three epicystous genera above mentioned, and *Acrocheilus*,* Ag., of Pacific waters, form a homogeneous group of lesser rank, partly coinciding with Professor Agassiz' "Tribe Chondrostomi" (Amer. Journ. Sci. Arts, xix, 96), but which cannot be defined by the structure of the lips, a feature which presents considerable modifications in the genus *Chondrostoma* itself. To this group Prof. A. adds *Exoglossum*, *Campostoma*, *Pimephales*,† and *Hyborhynchus*. The first two genera have been already treated of; the two last I have separated on account of the form of the dorsal fin. I therefore do not believe any

* See Gill on this genus, Proc. Acad. Nat. Sci., 1864.

† *Pimephales agassizii*, sp. nov.

Mouth short, terminal quite oblique, end of maxillary bone below nares, orbit one-fourth head 4.5 frontal width. Head equal, greatest depth 4.5 to origin of caudal. From latter to origin first dorsal ray less than from latter to end of muzzle. Scales narrowly exposed, 8-9—44—5; 29 rows anterior to dorsal fin; lateral line extending to below dorsal fin. Radii D. 18. A. 7. V. 8. C. 19. P. 16, tip $\frac{3}{8}$ to ventrals, latter to vent. Dorsal outline arched; front depressed behind line of nares. Total length 2 inches 11 lines; end muzzle to anal 1 inch 8 lines. Alimentary canal much complicated. Peritonæum with black pigment; above yellowish-olive, elsewhere dull silver; dorsal fin dusky, especially in a spot on anterior rays.

This species bears considerable resemblance to the *P. milesii* M., and the *Hyborhynchus notatus* Agass., and points to the identity of the two genera.

Habitat. A tributary of the Ohio at Richmond, Indiana. From a collection in Museum Academy, made by Elijah Coffin at that place.

trenchant division of the Cyprinidæ into the Phalacrognathi and Chilognathi, as has been proposed by Bleeker, exists in nature. Cochlognathus, Bd., Grd., which has also trenchant lips, is most allied to Hybopsis.

A species identical with Chondrostoma in dentition and other characters, is Leuciscus gardoneus, C. V., from South Carolina. Not having examined the splanchnology, I am unable to assign it definitely to that genus.

The description appended was taken from the types of Cuv. Val., in Paris.*

Species of this genus bear a strong analogical resemblance to such Ceratichthyes as C. biguttatus, in the small superior eye and decurved front, and especially during the breeding season, when the muzzle of the males is similarly swollen, and with the front and vertex ornamented with series of corneous tubercles.

The pharyngeal bones are characterized by the length of the superior limb; teeth straight.

The following is a synopsis of species known to the author:

Scales of lateral line 49—57.

Front elevated, diameter of eye near four times in depth of head; head 4.5 in length to caudal emargination; fins with median black band. End muzzle to origin dorsal longer than from latter to base of caudal; lip complete round mandible.

CALLIPTERYX.

Front plane, eye 2.5 in depth head; head 4.5 to 5 in length as above; eye 5.25 in head in adult; 3-5 in young of 3 in. End muzzle to first dorsal shorter than from latter to origin caudal. Lip not complete round mandible.

DUBIUM.

Front not elevated; eye 4.5 in head of young of 3 in.; head 5 in length as above; form of Semotilus.

GOBIONINUM.

Eye 5 times in head of young at 2.5 in. long; head, muzzle elongate decurved, 4.5 in length to notch of caudal.

MORMYRUS.

Of the above species Campostoma callipteryx was taken in the Flint River, Michigan (Proc. Acad., 1864, 284), and C. mormyrus and gobioninum from waters flowing into Lake St. Clair.

The C. anomalum, Agass. (*Rutilus anomalus*, Raf.), is stated by Prof. Agassiz to possess the dental formula 1.4—4.1; I have not yet met with it. He also states that the *Exoglos-*

* Chondrostoma gardoneum, m. e. Cuv. Val., from South Carolina, Bosc.

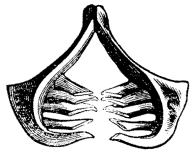
Sp. w. smaller eye, large scales, short obtuse nose. Isthmus very small. Mouth small, edges of jaws cutting, the under received into the upper, canthus opposite middle of narial concavity, direction a little descending; no barbels. Teeth 5—5 w. broadish masticatory surface, two superior a little hooked, and stand on an upward and backward projecting crest of the bone. Ventral opposite or a little in front of dorsal, 8 r. Anal 1—9, C. 19, D. 1—10.

Scales 7—39—3. Eye four times in head, one and four-fifths in frontal breadth. Head five and one-half in total length, and one and one-half in height. Yellowish greenish-black, apparently a weak vertical streak on anal fin. Acute scale behind ventral.

sum spinicephalum, Val., is identical with it. The latter differs from the *C. dubium* in the more numerous scales of the lateral line.

CAMPOSTOMA DUBIUM, *Kirtland*.

Exoglossum dubium, *Kirtland*, Journ. Bost. Soc. Nat. Hist.



I have twenty-nine specimens of this fish before me from the Youghiogheny, Pa., the St. Josephs, Michigan, and the White River, Indiana (W. P. Clark), and find no variation except in the scales of the lateral line, which, while usually 49 to 52 in number, in two of the White River specimens reach 55 and 57.

In this species the suborbital bone is narrow and sickle-shaped; the premaxillary bones are protrusile, and overarched by a strong dermal fold. The upper lip is long, but the lower not completed round the arch of the mandible.

The general form of this fish is elongate, with a deep caudal peduncle, this depth measuring nearly half the length of the head. Greatest depth one-fifth length to caudal emargination. Pectorals extend two-thirds length to ventrals, latter just to vent. Anal narrow, first rays not longest, its basis little over half greatest length. Dorsal small immediately over ventrals, its basis 1.5 height; latter .33 in length from its first ray to origin of caudal.

The scales, as in *Semotilus*, are more equally exposed in young than adult individuals, where they become crowded anteriorly and less exposed; number 7-8—49-57—8-7; lateral line nearly straight, elevated shortly at its anterior extremity.

The muzzle is elongate, and contains twice the diameter of the eye, or 2.5 the internarial width from hinder nostril above, or 1.5 the interorbital width. Frontal bones convex. R. D. 1. 8, C. +19+, A. 1.7, V. 1.8, P. 16.

Length 5 inches.

In adults the dorsal, caudal, and anal fins have a black median band. In spring the smaller specimens have the inferior fins and the caudal light orange without markings. General color, above leaden, below cream color with leaden tinge. The peritonæum of this species is black.

The *Campostoma* is a fish of comparatively slow movements, and readily takes a hook baited with a worm. It occurs in clear and calm waters, but is probably not averse to mud.

In completion of this synopsis, it is necessary to add two species of the family which have been introduced, the *Cyprinus carpio*, from Europe, and the *Carassius auratus*, or gold fish, from China, by way of Europe. Each represents a distinct group of the *Epicysti* preceding our Group I, with the following characters:

Group O. Barbels present; teeth of the molar type, with grooved crown, more than one-rowed. Alimentary canal elongate. Dorsal fin much elongate.

Teeth 1.1.3—3.1.1; both lateral and angular beards. Dorsal and anal fins with strong spines; basis of latter short.

CYPRINUS.

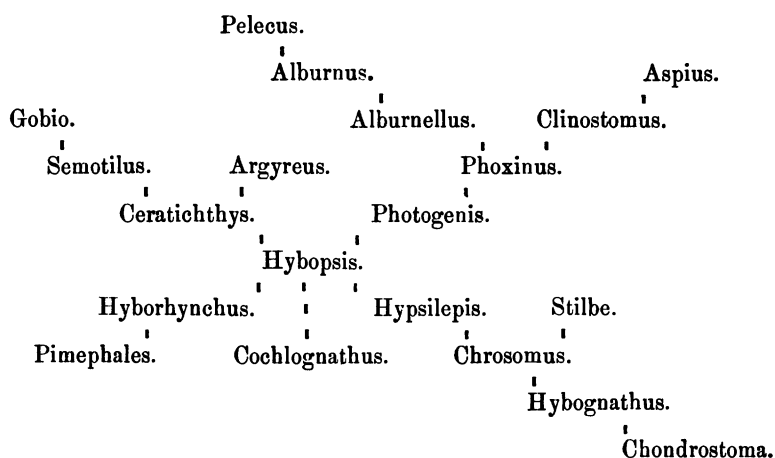
Group OO. Barbels none; teeth broad, flat, truncate, scalpriform, one-rowed; dorsal fin with elongate basis. Alimentary canal elongate.

Teeth 4—4; dorsal and anal with strong osseous spine; latter with short basis. Mouth terminal. CARASSIUS.

The carp is olivaceous, the gold fish varies from olivaceous to black, silvery, and crimson. Both are taken in the Schuylkill, the Carassius much the more abundantly, as I have witnessed, as far as Conshohocken, sixteen miles above Philadelphia; the latter fish occurs no doubt much higher up this river.

The crania of these, and of all other genera of Cyprinidæ, in individuals of all ages, I have found to be fully developed, while among Catostomidæ, as *Catostomus* (*Hylomyzon* and *Ptychostomus*) and *Carpiodes*, its superior wall is interrupted by a longitudinal fontanelle. In the genus *Cycleptus*, however, the cranium is as complete as in the Cyprinidæ. It may also be observed as characteristic of the two families, that in the latter the masticatory table of the basi-occipital occupies only the basal portion of the basi-occipital ensiform process, while in *Catostomus* the latter is entirely covered by a broad cordiform table, which is largely lacunary and not solid.

The characters of our genera of *Epicysti*, having been already given, their serial affinities may be usefully presented in the following form:



In connection with future study of this and other types of organized beings, the following observations on the probable law of evolution of types are appended.

In the present state of our knowledge, we believe the following laws can be established:

I. That genera form series indicated by successional differences of structural character, so that one extreme of such series is very different from the other, by the regular addition or subtraction of characters, step by step.*

II. That one extreme of such series is a more generalized type, nearly approaching in characters the corresponding extreme of other series.

* St. Hilaire, Owen, Agassiz.

II. That the other extreme of such series is excessively modified and specialized, and so diverging from all other forms, as to admit of no type of form beyond it.*

IV. That the peculiarities presented by such extremes are either only in part or not at all of the nature of adaptations to the external life of the type.†

V. That rudimental organs are undeveloped or degraded conditions of the respective characters developed or obliterated in the extreme of the series.

VI. That therefore the differences between genera of the same *natural* series are only in those characters which characterize the extreme of that series.

VII. That the relations of the genera of a series are those of the different steps in the development of the individuals of the extreme genus *ab ovo* (*Von Baer*, *Agassiz*), (with sometimes the addition of special adaptive features ?!).

VIII. That a natural (*i. e.* trenchant) genus is distinguished from its nearest affines by but few characters.

IX. And that their presence, rudimental condition, or absence, can be accounted for on the hypothesis of a greater rapidity of development in the individuals of the species of the extreme type, such stimulus being less and less vigorous in the individuals of the types as we recede from the same, or by a reversed impulse of development, where the extreme is characterized by absence or "mutilation" of characters.

X. That it therefore results that there is one primary structural type involved in such a series of species, which is made to present at any given period in its Geologic history that appearance of succession of genera ordained by Creative Power.

Illustrations of this proposition are innumerable. Thus in the important character of the branchiæ, some salamanders lose them before birth and are born alive; other viviparous species maintain them for a short time after birth; some are produced from the egg, but lose them very shortly after birth, without employing them functionally; others use them during a very short aquatic life, some maintain them longer, and some to adult age; finally, some Amblystomata reproduce while carrying branchiæ, thus transmitting this feature to their offspring as an adult character.

In both Perissodactylous and Artiodactylous Mammalia, certain types develop their family character of canines at the earliest appearance of dentition, others not till a comparatively late period of life (*Equus*), and the extreme genera never produce them.

Among Cetaceans the genus *Orca* maintains a powerful and permanent series of teeth;

* Leconte. Dana on Cephalization.

† Owen on Cetacea, Trans. Zool. Soc. Lond., 1866, 44. Leconte on Carabidæ, Trans. Amer. Philos. Soc., 1853, 364.

in Beluga the series is shed in old age, in Globiocephalus or the Caing whales they are shed at middle age, while in the Balænidæ, of which the absence of teeth is an essential character, these organs are developed, and absorbed *during foetal life* (Eschricht).

It is well known that the Cervidæ of the Old World develop a basal snag of the antler at the third year; a majority of those of the New World (genera Cariacus, Subulo), never develop it except in "abnormal" cases in extreme old age of the most northern Cariacus (*C. virginicus*); while the South American Subulo retains to adult age, the simple horn of the second year of Cervus.

Among the higher Cervidæ, Rusa, and Axis never assume characters beyond an equivalent of the fourth year of Cervus. In Dama the characters are on the other hand assumed more rapidly than in Cervus, its third year corresponding to the fourth of the latter, and the development in after years of a broad plate of bone, with points, being substituted for the addition of the corresponding snags.

Returning to the American deer, we have Blastocerus, whose antlers are identical with those of the fourth year of Cariacus.*

In the important character of the scutellation of the tarsi among the Passerine birds, the "boot" appears early in life in the highest Oscines, later in the lower, and does not appear at all in the majority. In respect to the still more important feature of the long posterior plates which appear very early in most Oscines, in the Myiadestes type they appear late, the squamæ remaining long, while the Clamatores never develop the plates, not advancing beyond the infantile squamous stage.

In reviewing these and many similar examples everywhere coming under the eye of the naturalist, it is easy to perceive what would constitute a *plastic* and what a *conserved* condition of generic, or even of specific form. Let the development of a special feature be postponed to a later period of the individual's life, so that nature's intention be but feebly indicated at the period of reproduction, and that feature will be but feebly represented in the offspring.

That every series of forms has had its period of great multiplication, or its "protean," and thus probably plastic stage, is familiar to the student of palæontology. At other times than these a *vis conservatrix* would seem to insure a nearly entire permanency of generic form.

The above *law of retardation and acceleration* is, however, only proposed as a partial explanation of the *mode* in which the progress may have occurred; the grand law of what has determined or projected the *series* of genera to its extreme remains untouched. That it could have been a natural selection, resulting from favorable or hostile relations of surrounding conditions, is contradicted by the facts on which Prop. IV is based.

* *Vide* the Illustrations of Cuvier's Ossemens Fossiles.

SUPPLEMENT

ON SOME NEW SPECIES OF AMERICAN AND AFRICAN FISHES.

APOGONICHTHYS STELLATUS.

Scales 7—23; radial formula, D. vii, I. 9; A. II. 8; P. 10. Ventral with elongate rays extending beyond last anal ray. Caudalis rounded. End of maxillary nearly to opposite posterior margin of large orbit. A delicate frontal carina. Greatest depth three times to base of caudalis. End of muzzle truncate, with emargination to receive tubercle of mandible. Total length 1 inch, 7.5 lines; head 7.5 lines.

Reddish-brown, with a series of dark brown spots on the edges of the scales of each row (except that bearing the lateral line), each with a silver centre; head with numerous silver-centred brown spots. Caudal, dorsal, and anal fins dark, with dusky crossbars.

Two specimens, Mus. Academy, procured by Prof. Horatio C. Wood, Jr., at Nassau, Bahama Islands.

This is the second species of the genus now known to inhabit American waters. The previously ascertained *A. americanus*, Castelnau, was obtained at Bahia, but has been discovered by Samuel Powell, member of the Academy, at Newport, R. I.

ETHEOSTOMA MACROCEPHALUM, Cope.

This species is well characterized by its elongate anguilla-like cranium, and small scales. It may be compared with the other species of the genus as follows:

E. peltatum, Stauffer, Proceedings Academy Nat. Sci., 1864.

Orbit equal length muzzle; depth at first ray second dorsal 5.75 in total length to origin caudal.

Scales 6—53—8, a few on opercle; those of abdominal series five times size of others. Radii D. XII. 13. A. II. 9.

E. blennioides, Rafinesque, Kirtland, Bost. Journ. Nat. H., vol. III.

Orbit equal length muzzle; depth to length (as above) 1 : 6.5.

Scales 8—62—13-14; some on operculum; those of middle line below twice size of others or wanting. Radii D. XV (XIV) 12 (13). A. II. 9.

E. macrocephalum, Cope.

Orbit much less than length muzzle; depth (as above) 7 times in length to origin caudal.

Scales 11—77—15, none on opercle; those of ventral line twice size of others. Radii D. XV. 13: A. II. 11; orbit four and a half times in head to apex of opercular spine. Interorbital width one-fourth length from end of muzzle to line of transverse measurement. End of os maxillare falls opposite anterior rim of orbit. Anterior to dorsal fin scaleless; abdomen entirely scaled. Basis of anal less than that of second dorsal by two rays, and an interspace of latter. Length head 3.5 to basis of caudal fin. Anterior to ventral fins entirely smooth.

Total length 2 in. 10 lin., ditto from end muzzle to origin first dorsal, ten lines; to origin second dorsal (well separated from the first) 1 in. 7 lin.

Above light brown, with a slightly undulating whitish band extending from superior opercular angle to superior surface of caudal peduncle; dorsal line marked by darker quadrate spots, with marked light interspaces. Lateral line and several rows of scales above and below, marked by nine blackish longitudinal spots with smaller ones alternating. A blackish band on muzzle to orbit. Head and body below straw color, except a narrow black line directed backwards below the pupil and cheek on the mandibular ramus. First dorsal with a median series of vertical black lines; second dorsal with three, caudal with four, and anal with a basal transverse black bar. Head spotted above.

Habitat. Three specimens of this Percid are in the Museum Academy Natural Sciences, procured by myself in the Youghiogheny River, Pennsylvania, with *Pleurolepis pellucidus*, Baird, *Catonotus flabellatus*, Rafinesque, and other interesting species. They occur in stony parts of the river, and are a graceful and active, as well as delicately colored species when living. The feature, apparently important, of a median abdominal series of spinous shields in the genus *Etheostoma* (noticed only before Stauffer by Girard, in the *E. maculatum*, *Alvordius maculatus*, Girard), is not present in a half-grown individual of the *E. macrocephalum*, the middle line of the abdomen being scaleless. In an *E. blennioides*, from the Kiskiminitas, Penna., of 34 lines in length, the shields are distinct, while in another of 30 lines, from Richmond, Indiana (obtained by Elijah Coffin), the same region is naked. These are probably a periodical development, appearing in the breeding season, like the corneous excrescences of the Cyprinidæ. They are appropriate defences to these fishes which lie or move upon rocky bottoms, and are unable to suspend themselves in the fluid medium for a length of time.

CRYPTOSMILIA LUNA, *Cope*, GEN. ET SP. NOV.

Char. gen. Fam. Chætodontidæ, affined to Drepane. No vomerine or palatine teeth; several long sharp spines on the inferior margin of the præoperculum. Dorsal fin with a deep concavity in front of the articulated portion, spinous portion not squamous, with ten

rays, of which the anterior is small and directed downwards and forwards. Anal with three spinous rays, its whole extent equal that of the soft dorsal. Branchiostegal radii six. Pectoral fin elongate.

Char. specif. Greatest depth of body between origins of dorsal and anal fins equal length of body from end muzzle to origin of caudal fin. Radii D. X. 21. C. +18+. A. III. 17. V. I. 5. P. I. 16. Osseous ray of pectoral very small; that of ventral very strong. Soft rays of ventral reaching to soft anal; ditto of pectoral to origin of caudal. Caudal angularly convex. Second and third spinous dorsals small, fifth much the longest.

Scales 11—43—27; lateral line describing a strong upward curve. Cheek and a patch on the branchiostegal membrane scaled. Orbit twice in length of head, two and one-half times in vertical line below superciliary ridge. Operculum narrower than scapular plate, with suboperculum over three times as high as wide; latter ascending to opposite inferior margin pupil. Præoperculum serrate behind and with nine cutting spines below. Mouth very small, projectile; teeth in numerous packed series, simple, acute.

Color. Everywhere uniform silvery.

Dimensions. Total length five in. six lin. Depth four in. one lin. From gular region to point of supraoccipital crest two in. six lin. Depth of soft dorsal and anal fins respectively one in. one lin., and one in. Height of fifth dorsal spine one in.

Habitat. Western African seas. Sent to the Academy by our correspondent, Dr. Thos. S. Savage.

This interesting type represents in its range, the Drepane of East Indian seas. Its peculiarity consists in its stronger armature, and increased number of dorsal rays.

CORVINA MONACANTHA, SP. NOV.

A species differing from those hitherto described, in having one anal spine, no pseudobranchiæ, and more numerous dorsal rays. The pseudobranchiæ are ? wanting (Günther), in *C. microps*, Steindachner, and in some others, the first anal bony ray is very short.

The greatest depth (at front of dorsal fin) equals length of head; præoperculum sharply serrate on vertical margin.

Scales 10—16—49 at ventrals; lateral line continued to end of subanceolate caudal. Diameter of eye one-fifth head. Pharyngeal patches small; teeth bristly. D. 10. 1. 33. C. 17 A. 1. 5; V. I. 5, first articulate prolonged into a filament, which reaches beyond vent; P. 18 as long as tip ventrals without filament. Silvery everywhere, without spots; dorsal region grayish.

Total length 8 in. 6 lin.; end muzzle to base of caudal 6.75 in.; same to base of anal 4.5; same to base of pectoral 2.2.

Habitat. Near Parimaribo, Dutch Guiana. Dr. Hering, Mus. Academy Nat. Sciences.

CHIROSTOMA BERYLLINUM, SP. NOV.

Form of body shorter than usual; posterior margin of first dorsal far in advance of second dorsal, and just in front of opposite first anal ray; last anal a little behind last ray of second dorsal; tips of ventrals opposite first ray of first dorsal. Head 4.25 times to base of caudal. Orbit large, one-third head; mouth small, mandible slightly longer, curve forming a quadrant. Greatest depth (in front of anal) six times in length to basis of caudal.

Scales large, ten longitudinal, thirty-six transverse rows; lateral line represented by a pore on the anterior part of the posterior field of each scale, except on the caudal peduncle, where there is a groove. The anterior separated portion of the line is on two adjacent series of 5—4 scales each. Radial formula D. V, last well developed; I. 11. C. 17, deeply furcate; A. I. 18; V. I. 5, four interior twice furcate; P. 15 acuminate.

Total length 2.5 inches; end muzzle to base of first dorsal 1.06 inches.

Color. Bright pale olive, a silver band from axilla to caudal on two half rows of scales, leaden margined above; basis of anal leaden. Sides of head silvery.

Habitat. The only specimen I possess of this species I procured in the Potomac River, at Washington, D. C.

GOBIOUS DOLICHOCEPHALUS.

Intermediate between *G. banana*, C. V., and *G. mexicanus*, Gthr. Radial formula D. 6—11, A. 1—10.

Scales 68 in lateral line, 21 rows between second dorsal and anal; those in front of dorsal fin minute; head entirely naked. Caudal fin rounded, not elongate, one-sixth of length. No canine teeth. Interorbital width equal diameter of eye, which enters head 5.5 times, and enters 2.2 in muzzle. End of maxilla opposite anterior margin of orbit. Ventrals shorter than pectorals, falling far short of vent, with broad anterior connecting membrane. Breadth of head greater than depth, and more than half length of head; depth of body one-sixth of total. Yellow olive above, with black marbling on the sides. Spot at upper origin of pectoral, and upper angle operculum; top of muzzle and edge of lip black. First dorsal faintly, caudal strongly barred with black; second dorsal with rows of black spots on each ray. Fins and surface below, yellowish.

Habitat. Near Orizava, Vera Cruz. Prof. Sumichrast, Mus. Academy and Smithsonian.

The differences between this species and the *mexicanus* result from the greater shortness of the body in the former, increased width of head, and small size of eye. To our measurements are appended those of the latter, taken from Günther's "Catalogue":

	<i>G. dolichocephalus.</i>					<i>G. mexicanus.</i>				
	in. lin.					in. lin.				
Total length,	7	0	.	.	.	8	0	.	.	.
Height of body,	1	0	.	.	.	1	1	.	.	.
Length of head,	1	7	.	.	.	1	8	.	.	.
Greatest width of head,	1	0	.	.	.	0	11.	.	.	.
Diameter of eye,	0	3.25	.	.	.	0	2.5	.	.	.
Length of caudal fin,	1	1.5.	.	.	.	1	0	.	.	.

AGENIOSUS PORPHYREUS.

Head three and two-thirds in length to origin of caudal, covered on the occiput with smooth skin. Eye its own diameter behind rictus oris. Maxillary barbel concealed, not attaining rictus by its length. Pectoral fins not attaining ventrals; the spine acute, smooth behind, three and one-third times in length of head. Ventrals falling far short of anals; caudal deeply forked. Dorsal spine slender, flexible, rugose in front; formula D. 1.7. C+18+. A. 44; V. 7. P. 15.

Color. Back and narrow extension on sides, with nape and top of head, brown purple, irregularly marbled throughout the length with the silvery of the sides, which is prolonged anteriorly as a band to the occiput. An eye-like spot between gill opening and dorsal fin on each side. Side of head and below yellowish.

Habitat. Surinam. Dr. Charles Hering, Mus. Academy Nat. Sciences.

This fifth species of the genus is allied to Kner's *A. dentatus*, from near Para.

PIMELODUS (RHAMDIA) BRACHYPTERUS.

D. 1.6 A. 11. P. I. 9. Adipose fin about equal from its anterior extremity to origin of first dorsal ray, three and two-thirds times in length from end of muzzle to base of caudal. Occipital process short. Maxillary barbels to beyond first dorsal, external mandibular to axilla. Height of body at anal fin equal same at first dorsal, five and one-third times to base of caudal; length of head five and two-thirds in same. Greatest width of head three-fourths its length. Mandible a little shorter, intermaxillary band one-fifth as long as broad. Eye nearer extremity muzzle than to opercular border, diameter nearly half

frontal width. Dorsal fin longer than high, spine very weak. Pectoral spine striate distally, flexible, strongly serrate on inner margin. Anal laid backwards, reaches line of adipose. Caudal deeply emarginate, lobes narrowly rounded, one-eighth total length. Operculum and occipital region radiate grooved.

Above blackish, below silvery, a light shade across middle of dorsal fin.

This species differs from its ally, *P. motaguensis*, of Guatemala, in its smaller eye, much deeper body, and slight differences in the radial formula.

From Orizava, Mexico. Prof. F. Sumichrast, Mus. Academy, Smithsonian.

ENGRAULIS DUODECIM, SP. NOV.

This fish was taken at Beesley's Point, New Jersey, by our late fellow member, Samuel Ashmead, and by him presented to the Academy. It differs from both the *E. vittatus* and *E. brownii* in having the dorsal fin entirely anterior to the anterior ray of the long and deeply concave anal, and in the serration of its belly.

Scales with twelve transverse undulate grooves, large, in eight longitudinal, and thirty-four transverse rows. Greatest depth in front of dorsal, one-fourth length to base of caudal; length of head three and two-thirds in same. Middle pupil marking less than one-third distance from end muzzle to end maxillary; eye 4.5 in head. Pectorals reaching ventrals, r. 12; ventrals not attaining vent, r. 7; anal 1.27; caudal deeply forked. Total length 3.87 inches; end muzzle to base dorsal (straight) 1.625 inches; rays of latter 1.12, the anterior five times the height of the posterior.

Iridescent silvery, dorsal region pale brownish (in spirits).

ENTEROMIUS POTAMOGALIS, Cope, GEN. ET SP. NOV.

Char. gen. That of *Labeobarbus*, with the peculiarity of short alimentary canal, equal the length of the head and body, and of articulated second dorsal ray instead of a spinous one. Pharyngeal teeth with very shallow concavities.

This genus therefore combines general features of *Gobio* with the dentition of *Labeobarbus*.

Char. specif. Form compressed and gibbous. Inferior limb of pharyngeal bones two-thirds length of superior, a slight external angle; teeth 2.3.5—5.3.2, the inferior of the longer row very small and conic. Radii D. I. 9. C. +19+. A. II. 6. V. I. 8. P. 15. First long dorsal ray weak as the last, and not a spine, hence counted with the branched rays. Ventrals not attaining vent, but reached by the acuminate pectorals. Orbit four times in head, diameter less than length of muzzle, latter rather broad. Outline steeply descending

from front of dorsal fin. Head 4.2 in length to origin of caudal; four well-developed barbels. Greatest depth three times in length to origin caudal.

Scales large, minutely granular, with few (5-8) and coarse radii, 4—22-3—2-3. Several rows extend over the basal third of the caudal fin. Total length 4 inches 9 lines; to origin dorsal (oblique) 10.5 lines; to origin anal 2 inches 9 lines. Lateral line little deflexed.

Coloration. A broad, straight, dark brown band from end muzzle to origin caudal fin, which is light and dark margined above. Above dark cinnamon brown, each scale silvered; below paler brown, each scale with a deep brown spot at base; tip of dorsal fin brown.

The anterior tract of the alimentary canal falls a considerable distance short of the vent, while the second flexure is produced to the anterior extremity of the abdominal cavity, being slightly prolonged to one side. The distal portion is slender. Among the ingesta were found remains of crustaceans.

The natatory bladder extends to the posterior extremity of the abdominal cavity.

Habitat. This species was procured by the African traveller, P. B. Duhaillu, in streams and rivulets fifty to sixty miles north of the equator, and the same distance from the ocean.

LABEOBARBUS AUREUS, *Cope*.

Pharyngeal bones without external angle, inferior limb from tooth series a little shorter than superior from other extremity of same; teeth 2.3.5—5.3.2.

Scales 5—37—2, lateral line decurved, rising at front of anal fin. Rays D. II. 8. C. +19+. A. II. 6. V. II. 9. P. 18. Second dorsal spine slender, terminal third articulated; pectorals not reaching ventrals; latter falling short of vent, having elongate scute in axilla, and median plate below; anal appressed, extending two-thirds distance to vent. Outline arched from dorsal, muzzle depressed, projecting; four well-developed barbels. Eye one and two-fifths times in muzzle, four times in head; latter 3.8 times to origin caudal. Greatest depth 3.75 in same. Above, to second row above lateral line, brownish olivaceous; below this point and on sides of head, golden.

Length to end caudal 9 inches; to base of dorsal 3 inches 6 lines; to origin anal 5 inches 5 lines.

Habitat. Two specimens of this species were sent to the Academy by our correspondent, Dr. Alden Grout, from the Umvoti Mission, near the boundary between Zulu Land and Natal, South Africa. The species is nearest the *L. mariquensis*, Smith, of Central South Africa.

SPHAGOMORUS ERUMEI, GEN. NOV.

Hippoglossus erumei, Cuv. *Psettodes erumei*, Gthr.

This East Indian species has been assigned by Dr. Günther (Catalogue) to Bennett's genus, *Psettodes* (Proc. Comm. Zool. Soc., London, 1831, 147), and the West African *P. belcheri*, Benn., identified with it, with doubt. The Academy Natural Sciences having received from our correspondent, Dr. Thomas Savage, a fine specimen of *Psettodes belcheri*, from the coast of West Africa, I am able to ascertain its generic distinctness from the above mentioned East Indian form, although, as in the case of *Drepane* and *Cryptosmilia*, the two are surprisingly similar. The genera differ as follows:

Sphagomorus, Milei.

Maxillary and mandibular teeth simple.

Vent between the ventral fins.

Psettodes, Benn.

Maxillary and mandibular teeth with
sagittiform or barbed point.

Vent much behind the ventral fins.

The *S. erumei* has the jaws smooth; they are scaled in the *P. belcheri*; the lateral line is slightly oblique anteriorly in the latter, in the former distinctly arched. In *P. belcheri* the caudal fin is scaled to near the tip; the form of the body is less elevated than in Richardson's figure of the *erumei* (Voyage Sulphur). The scales of the lateral line, radial formulæ, and coloration, are identical with those of the *Sphagomorus*.

SUPPLEMENTARY SYNOPSIS

OF THE ESOCES OF MIDDLE NORTH AMERICA.

Six species of *Esox*, inhabiting our waters may be defined as follows. Others have been described, but in such a way as to leave it doubtful whether they really exist. Girard has pointed out the differences in squamation of the head, and the author has given a synopsis of the species,* which, however, possesses many defects, owing to the inclusion of species on the basis of imperfect published diagnoses.

I. Operculum and cheek entirely scaled.

Branchiostegal rays 12—13 (14); front grooved. Dorsal radii 2.12—14.

End of muzzle to pectoral fin shorter than from ventral to pectoral; same to orbit less than from orbit to margin operculum; scales between ventrals and pectorals larger, 37 rows.

FASCIATUS.

* Proceedings Academy Natural Sciences, 1865, 79.

End of muzzle to pectoral longer than from pectoral to ventral; same to orbit less than from orbit to opercular margin; scales between ventrals and pectorals small, 44–50 rows. POROSUS.

End of muzzle to pectoral longer than from pectoral to ventral; same to orbit equal from orbit to opercular margin; scales between ventrals very small, 52–57 rows. UMBROSUS.

Br. R. 14–16.

Dorsal outline straight; pectoral fin nearer ventral than end of muzzle. D. 18. A. 17. Depth six times to base of caudal. End of muzzle to orbit equal from orbit to opercular border or beyond. RETICULATUS.

D. 22. A. 21. Probably, not certainly, in this section. DEPRANDUS.

II. Cheek entirely, operculum half, scaled.

Dorsal outline horizontal; pectoral nearer end of muzzle than to ventral. B. 14–15. D. 19. End of muzzle to orbit equal from orbit to border of operculum. Frontal groove deep. LUCIUS.

III. Cheek and operculum half scaled.

B. 19. D. 19. No front groove. NOBILIOR.

ESOX FASCIATUS, *Dekay*, Geol. Surv. N. York.

E. ornatus, Girard, Pr. Bost. Soc. N. H. Storer, Amer. Acad. Arts, Sci., Tab. xxiv, Fig. 2.

Besides the characters above pointed out, this species possesses the following:

Anal radii 4.11–12; scales 12–13 (below dorsal) 92–107 l. l. 11–13 (above ventral). Br. R. 12–13. From basis of caudalis to opposite first ray of dorsalis three times to the preoperculum, or a short distance in advance of it. Head three and one-half times to end of caudal fin. Eight rows of scales on the cheek.

The stout form and large thoracic scales of this species are well indicated in Storer's excellent figure. The colors are very dark, and become bars directed forwards on the inferior lateral region.

Length of adult 10 inches; greatest depth 1.375 inches.

Five specimens of this species are in the Museum of the Academy, three of them adult, procured in Long Island, N. Y., through the kindness of my friend Thomas Bland, of Brooklyn. They present no variations.

ESOX POROSUS, *Cope*.

Esox cypho, Cope, Proc. Academy Natural Sciences, 1865, 78.

The additional characters of this species, in which it will be observed it is quite identical with the preceding, are:

Radii, branchiost. 12–13; anal 3.12. Scales 11, 109–113, 12. Basis of caudalis to

basis of first dorsal ray three times to margin of præoperculum, or a short distance in front of it.

Var. A. All the abdominal, and most of the lateral scales give vent to a tube like those of the lateral line, at the bottom of a deep emargination. The head is contained four times in the length to the end of the caudal fin. Color, with broad brown bars directed obliquely forwards on the sides, or more numerous narrow black lines.

Of this variety there are numerous specimens in Museum Academy, from the neighborhood of Philadelphia, from Darby Creek, and the black lined form from White Clay Creek, Chester County, procured by my friend Vincent Barnard, of Kennett Square. It does not inhabit the running waters, but may be seen at any time in the "cut offs" and pools or dams, under the shelter of the broad leaves of the Nuphar advena, or among the Pontederias and Potamogetons. It will seek out such situations through the most insignificant outlets and rills, where it would seem to be in constant danger of having its retreat cut off. It does not attain a large size.

Var. B. Few or no tube-bearing scales, except those of the lateral line; abdominals entire; length of head three and one-half times in length to end of caudal. Broad oblique lateral bars.

Four specimens from Michigan, described formerly as *E. cypho*, and only differing from Eastern specimens as above. I have thought best to erase the name *cypho* (hunchback), as the feature it expresses is probably to a considerable extent the result of distortion.

ESOX UMBROSUS, *Kirtland*.

Cleveland Annals Science, 1854, p. 79. *Esox?* Cope, Pr. A. N. Sci. Phila., 1865, 79 (Grosse Isle).

In addition to characters given above, this species possesses the following:

Branchiosteg. radii 12—14; anal 2—3. 12; scales 12—15, 113—122, 13—15. Ten to twelve rows of scales on the cheek.

Var. A. From basis caudal to opposite basis dorsal three times to between præoperculum and orbit, or to between posterior margins of orbits (in specimens from Richmond, Indiana); brown bars on the sides directed forwards below.

Three specimens, one from Grosse Isle, near Detroit, one from Michigan City, Ia.

This variety, or the preceding species, may be that referred to by Prof. Kirtland as the *E. fasciatus*, found in Ohio.

Var. B. From basis caudal to opposite first dorsal ray three times in length to anterior

margin of orbit, hence with longer caudal peduncle than any of the preceding species and varieties. Color uniform leaden, without bars or spots. Length 10 in., depth 1.5 in.

Two specimens from the Susquehanna, procured by Jacob Stauffer, Sec. Linnæan Society, Lancaster. This may be typical of the *E. umbrosus*, as Prof. Kirtland does not represent any lateral bars; nevertheless, it cannot be decided from his description.

In the three preceding species the band of vomerine teeth is nearly equal in length to the palatine, sometimes a little longer, sometimes a little shorter.

ESOX RETICULATUS, *Leseuer*.

The common pike of the large Eastern Atlantic coast streams; not known from the interior. Well figured by Storer, l. c.

ESOX DEPRANDUS, *Leseuer*, Cuvier and Valenciennes, N. H. Poissons.

Not observed since Leseuer's time; from the Wabash.

ESOX LUCIUS, *Linnaeus*, Cuvier, Richardson. Cope, Proc. Acad., 1865, 79. *Esox estor*, Leseuer, Journ. Acad. I, p. 413.

The Great Lakes; Lake Whittlesey, Minnesota; John H. Slack, M.D.

ESOX NOBILIOR, *Thompson*.

Hist. Vermont, and Proc. Bost. Soc. N. H., 1850, 305, where this is rightly stated to be the *estor* of Richardson. It is also evidently *estor*, Agassiz, Am. Journ. Sci. Arts, xvi, p. 308, and formerly of Kirtland, but later correctly named by the latter, Cleveland Annals of Science, 1854, p. 78; also *E. lucioides*, Agass. and Gir., in Frank Forester, by Herbert. Fine specimens from Saginaw Bay, No. 228. A specimen is in the Academy Museum from the Alleghany River, in Warren Co., Pa., and another was presented by Thaddeus Norris, from Coneaught Lake, Crawford Co., Pa. The head of the latter measures 12 in. 9 lin. in length, and 17.6 in circumference at the preopercles.

General habitat. The Great Lakes, River St. Lawrence, and Lake Champlain.

PLATE X.

Fig. 1. SEMOTILUS RHOTHEUS. *Cope.*

“ 2. SEMOTILUS CORPORALIS. *Mitch.*

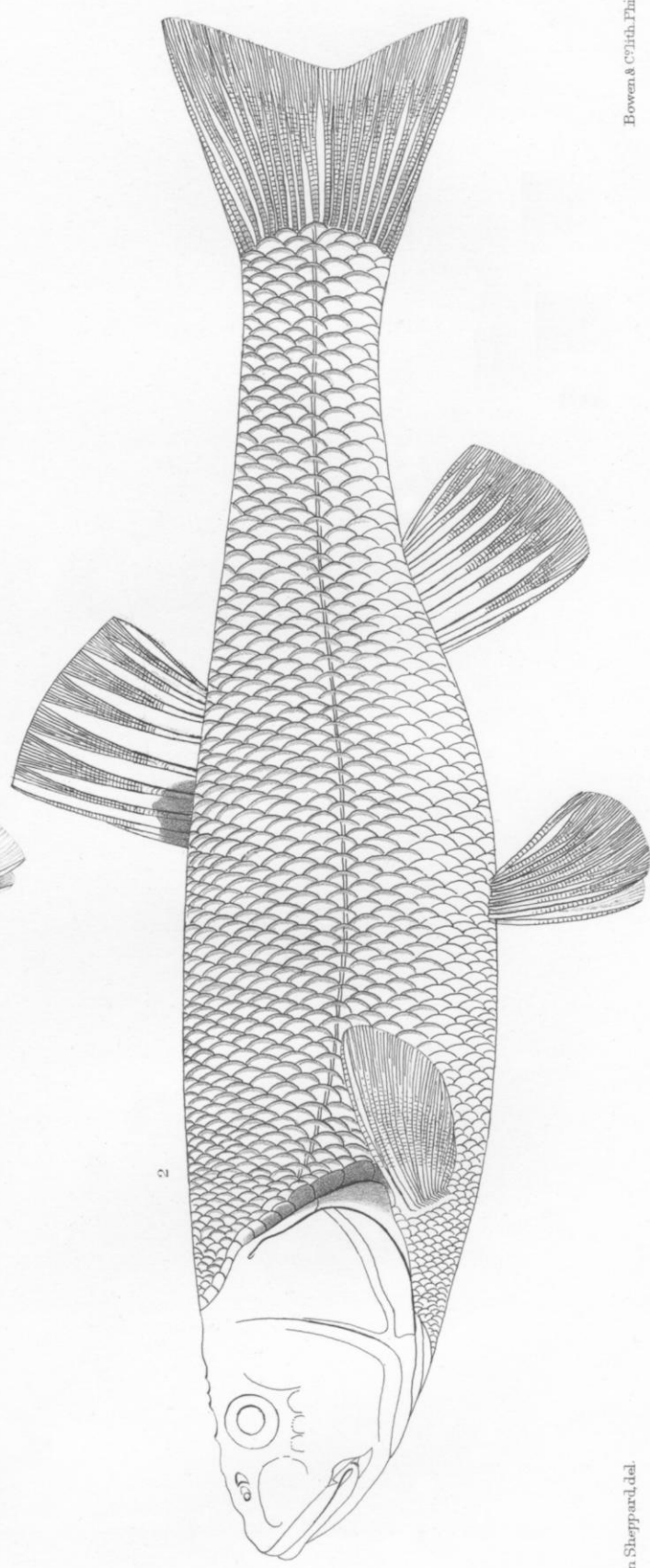
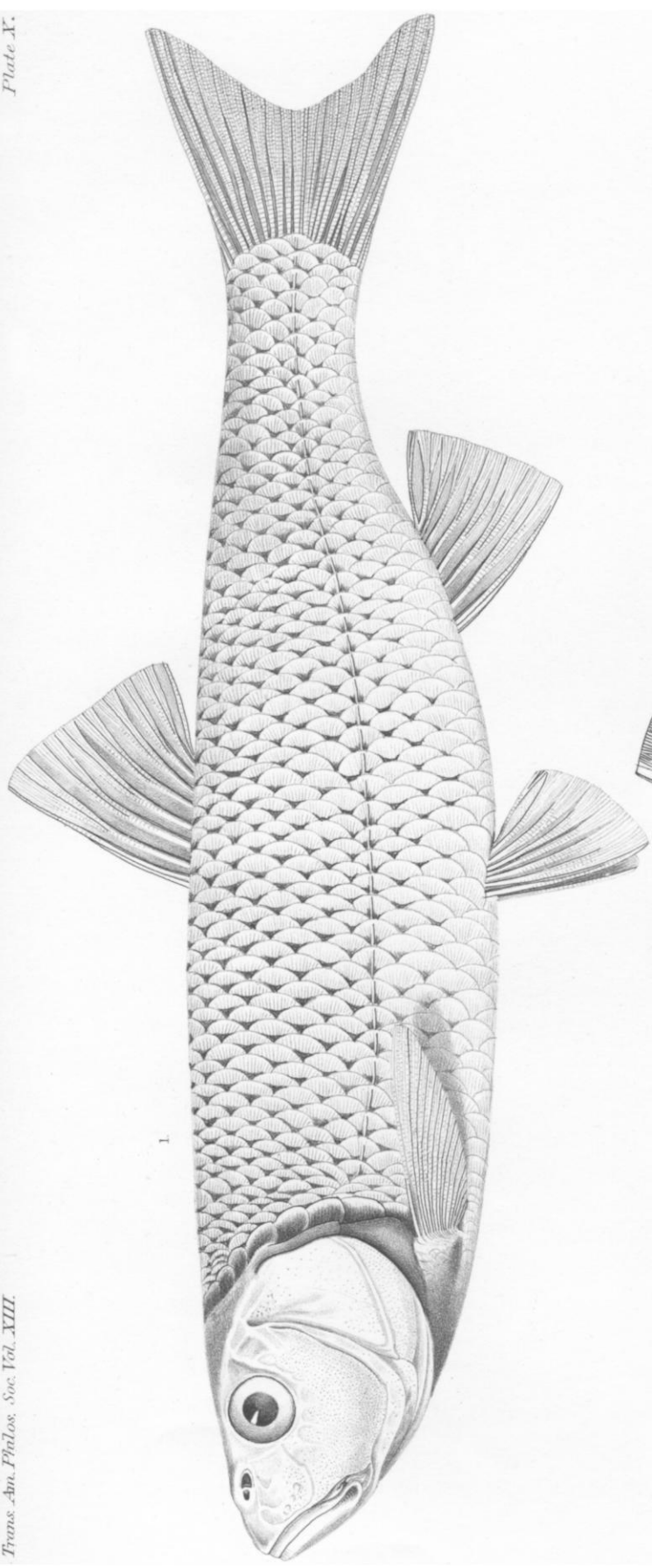


PLATE XI.

Fig. 1. EXOGLOSSUM MAXILLINGUA. *Les.*

“ 2. HYBOPSIS PROCNE. *Cope.*

“ 3. HYPHILEPIS KENTUKIENSIS. *Raf.*

“ 4. CERATICHTHYS PROTHEMIUS. *Cope.*

“ 5. CERATICHTHYS BIGUTTATUS. *Kirtl*

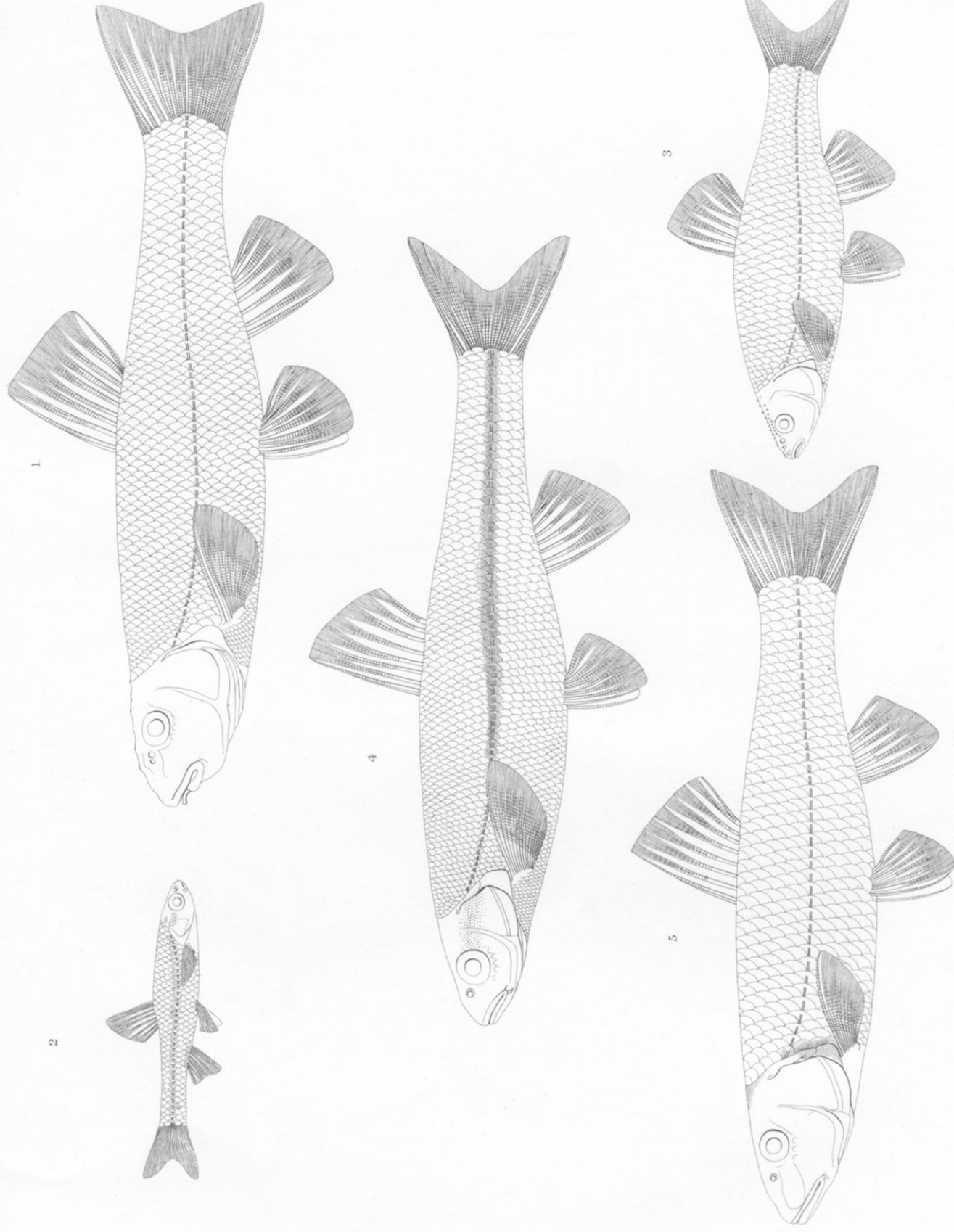


PLATE XII.

Fig. 1. CERATICHTHYS DISSIMILIS. *Kirtl.*

“ 2. CERATICHTHYS MICROPOGON. *Cope.*

“ 3. HYBOPSIS HUDSONIUS. *Clinton.*

“ 4. HYBOPSIS HÆMATURUS. *Cope.*

“ 5. ARGYREUS NASUTUS. *Ayres.*

“ 6. PHOTOGENIS LEUCOPS. *Cope.*

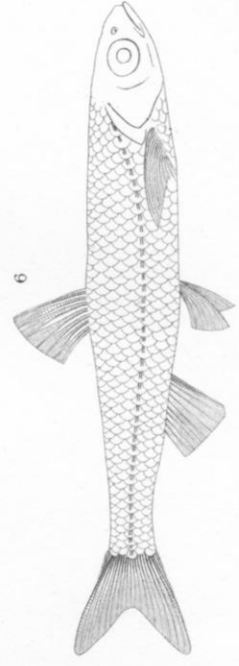
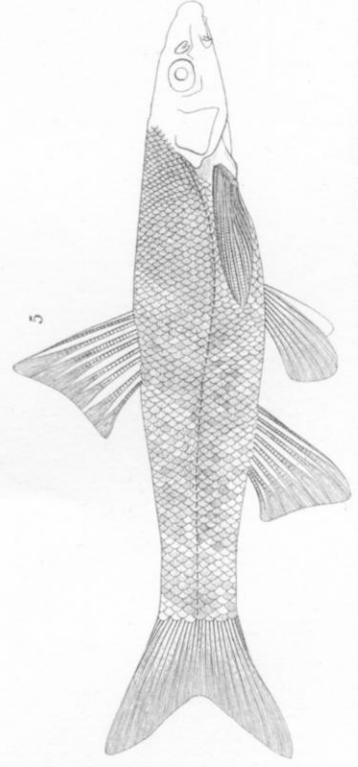
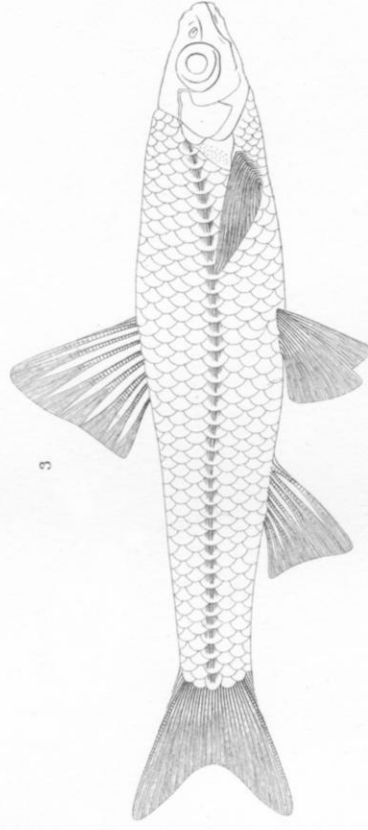
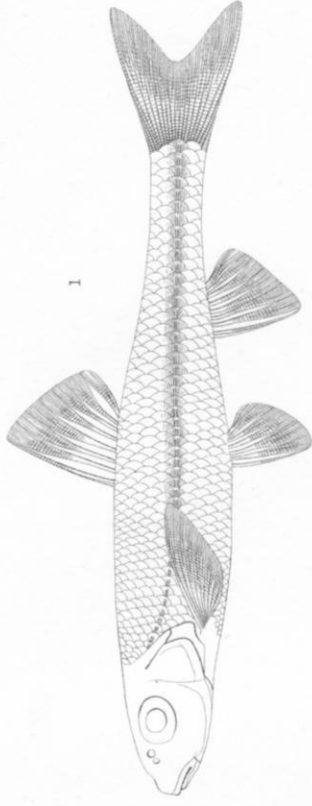
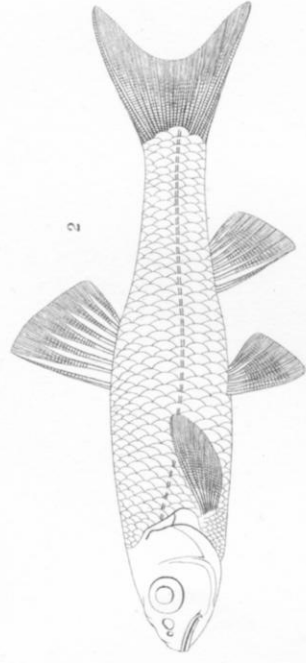


PLATE XIII.

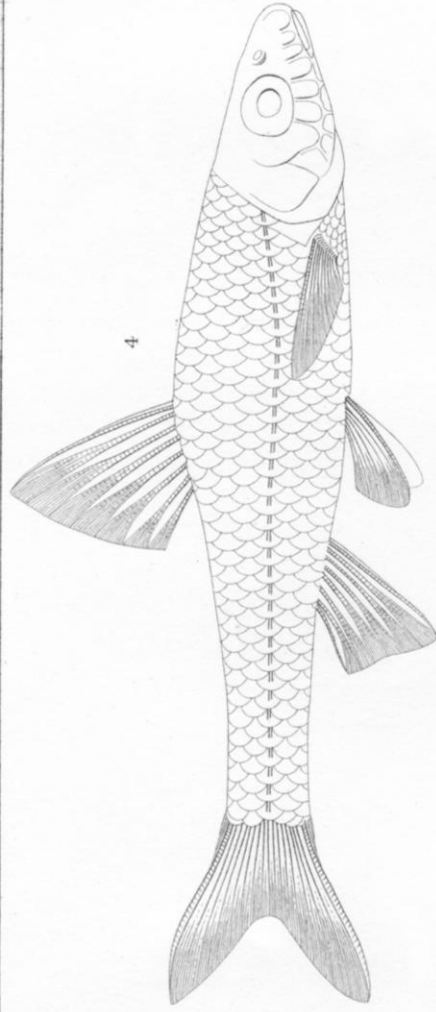
Fig. 1. CLINOSTOMUS MARGARITA. *Cope.*

“ 2. CLINOSTOMUS FUNDULOIDES. *Girard.*

“ 3. ALBURNELLUS RUBRIFRONS. *Cope.*

“ 4 and 4 a. ERICYMBA BUCCATA. *Cope.*

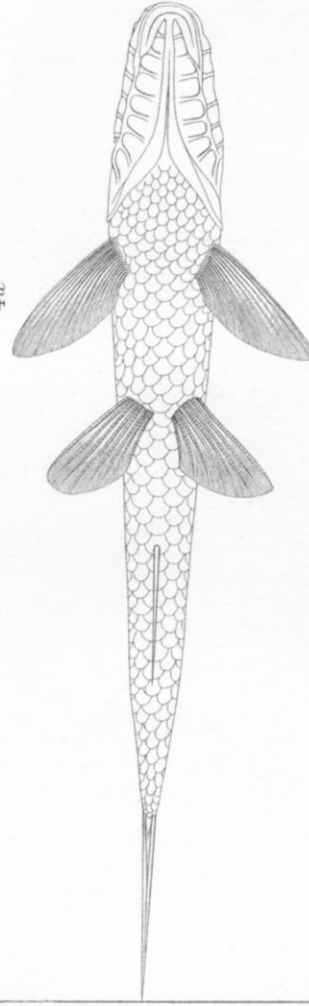
“ 5. HYBORHYNCHUS NOTATUS. *Rafinesque.*



1



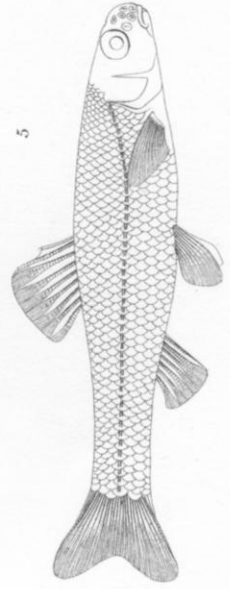
4a



3



5



2

